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MICHIGAN STATE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

EAST LANSING

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MICHIGAN STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

L. M. TURK, DIRECTOR
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USE OF NARLENE[1] FOR THE CONTROL OF NUCHE IN CATTLE[2]

INTRODUCTION

THE PARASITE, *Dermatobia hominis*, is commonly called the nuche in Colombia. It must not be confused with the common cattle grub, which is of no concern in that country.

Life Cycle of The Nuche

Many aspects of the life cycle of the nuche have not yet been fully explained. However, Gallego[3] reports that the adult female fly deposits her eggs chiefly on the bodies of other flies which molest cattle and sometimes on vegetation in the pasture. Each female may deposit 600 to 700 eggs.

When an animal is attacked by a vector fly burdened with eggs the latter are shed on the hide. Also an animal picks up eggs when tramping through vegetation on which they have been deposited.

Gallego[4] indicates the incubation period of nuche eggs is 5 to 7 days. In a few cases the egg may hatch on the vector fly and the minute larva is transferred to the hide.

The larva perforates and penetrates the animal's hide. This is the stage when the damage occurs. The larva attains a size of about 1 inch in length and ¼ inch or more in diameter. When the larva completes its stage within the animal's hide it drops to the ground, enters to a usual depth of ½ inch or more and undergoes the pupal stage. According to Gallego[5] this stage under normal conditions continues

[1](0-(4-tert. butyl-2-chlorophenyl) 0-methyl methyl phosphoramidothioate).

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[3]Gallego, Francisco Luis M. (1958). Information to authors.

[4]Gallego (1958). Op. cit.

[5]Gallego (1958). Op. cit.

for about 30 days. If the soil is too dry the pupa may lie dormant for as long as 40 days or more at which time, with a slight moistening of the soil, the adult fly may emerge within 24 hours. Normally the adult lives for 8 to 10 days; under some conditions this may be extended to 2 or 3 weeks.

Damage From Nuche

Many experienced cattlemen and veterinarians in Colombia feel that the nuche is the worst plague that affects cattle in that country. Posada[6] quotes reports that in the state of Antioquia more than 35 percent of the hides that are produced show nuche damage. The price per hide may be reduced by $2.00.

Besides hide damage the animals suffer annoyance and do not eat properly. Fattening for market may be delayed by 2 to 3 months; with milk cows the yield may be reduced by 25 percent.

Indirect effects of nuche are serious. Exudates from the wounds attract other insects which may produce further infection and disease. Vigor and resistance of animals are greatly impaired.

Body Areas of The Animal Most Affected

Most of the nuche are concentrated along the animal's shoulders and sides. Animals are most annoyed by flies that alight on their shoulders. Here the nuche are protected because the animal cannot dislodge them. After a few eggs have hatched and the larvae have entered the hide the exudate from the wounds attracts more flies. The area becomes a cluster of nuche and a mass of diseased tissue.

ENVIRONMENTAL FACTORS AFFECTING INFESTATION

Elevation

Nuche infestation in Colombia is largely restricted to the intermediate elevations. Seldom is there serious infestation at elevations below 2,200 feet or above 7,000 feet. However, Gallego[7] indicates that in recent years there has been a widening of these extremes. The pest seems to be adapting itself to lower and higher elevations.

[6]Posada, Samuel S. (1952). Control del nuche y la garrapata. Seminar Paper. Facultad de Agronomía, Medellín, Colombia.
[7]Gallego (1958). Op. cit.

Fig. 1. A moderately infested animal showing the areas that usually carry most nuche-shoulders and sides.

Temperature

Doubtless, the effects on nuche infestation that are attributed to the elevations are actually attributable to the temperatures. The nuche thrives at between 65° and 78° F. This is the range that prevails at most of the intermediate elevations.

Season

In Colombia, with no regular sequence of the four seasons, the temperature at a given elevation is quite constant throughout a year. Each year, however, there are two dry and two rainy seasons each lasting normally about 6 weeks. Between these are the periods of gradation in daily rainfall as one season blends into the next. Some years one of the seasons may be abnormally long and last several months.

With respect to the influence of the seasons on nuche infestation there is notable disagreement among experienced cattlemen and veterinarians. Some men claim the nuche is most serious in dry seasons; some say it is worse during the rains. Such disagreement would indicate that normally the season has little effect on infestation. Trial I

reported here was conducted during a dry season. Trial II was conducted during a rainy season. It was not apparent that the degree of infestation varied between these normal seasons.

However, Trials III and IV were conducted during the abnormally prolonged dry season which lasted from October, 1957 into April, 1958. It appears there was some decline in nuche infestation as this exceedingly dry season progressed. Likely the very dry soil was not conducive to the normal emergence of the adult flies.

Color and Quality of Hair and Breed

In these trials the darker colored animals seemed to be more susceptible to nuche than those of lighter color. An animal of broken color shows more infestation in the darker areas. In the trials the Santa Gertrudis, with their red color and long hair, showed more nuche than other breeds. The Criollos, or native cattle, often are quite brown or black and are seriously affected.

The native breed, Blanco Orejinegro, especially adapted to the intermediate elevations of the country, has a white body with black ears, muzzle, switch, and feet. They showed fewer nuche than most other cattle. The Cebús with their light color and short, fine hair were usually quite free of infestation.

Fig. 2. On the broken colored animal, the nuche concentrate in the black area. The white may remain entirely free.

OBJECTIVES OF THE STUDY

1. Ascertain the effectiveness of the four formulations of Narlene, a systemic animal insecticide, in killing nuche in the hides of cattle.
2. At intervals following treatment, extract manually and make careful counts of the number of nuche that were dead, the number alive, and the number of empty cysts. To do this, representative animals of each lot were used.
3. Ascertain the effects of treatments on weight gains of 1½-year old animals of both sexes. Careful counts of the nuche were not regularly made.
4. Ascertain the ease and feasibility of using each of the four formulations.
5. Compare the effectiveness of different methods of administering two of the formulations. The 25-percent wettable powder was used as a spray and as a drench; the emulsifiable, injectible material was administered subcutaneously and intramuscularly.
6. Observe effects of larger dosages than those which had been prescribed by the company.
7. Establish the length of time that the treatment would be effective.

It was not possible to outline any trial to discover the effects of the treatments on milk yields nor on the presumed improved vigor and resistance to disease.

THE FOUR TRIALS IN THIS STUDY

The four trials were conducted at different locations as shown in Table 1.

In Trial IV an additional group of 24 older steers in three lots have been treated and are under study to ascertain effects of the treatments on market value and carcass quality. Data on them will not be available until the steers are marketed.

MATERIALS AND METHODS

Narlene—The Product Used

Narlene is the trademark name of a systemic animal insecticide manufactured by the Dow Chemical Company, Midland, Michigan

TABLE 1—The four trials

Trial No.	Name of farm and owner	Elevation (feet)	Season	Number of lots and animals in each	Breeds (*a*)	Sex of animals
I	Montenegro Fondo Ganadero	2,000 to 2,500 at different pastures	Dry August and September	6 lots 15 in each	Cebú Santa Gertrudis BON (*b*) Criollo	bulls steers cows heifers calves
II	Libano Dr. Fidel Ochoa V.	1,800 to 2,000 at different pastures	Rainy October	5 lots 4 in each	Cebú Criollo	bulls steers
III	La Ley Drs. Carlos and Jorge Fernandez	2,200	Dry February and March	3 lots 5 in each	Cebú	steers
IV	El Carmen Sr. Erwin Leibrand	5,200	Dry December through March	3 lots 14 in each	Cebú	steers heifers

(*a*) Mostly grades, but Santa Gertrudis were all purebred.
(b) Blanco Orejinegro.

TABLE 2—Formulations used in each trial

Trial	Formulations used
I	Pills—orally 25-percent wettable powder as ¾-percent spray 25-percent wettable powder as drench—in 1½ pints of water per animal Emulsifiable material injected subcutaneously in front of shoulder Emulsifiable material as ¾-percent spray
II	Pills—orally 25-percent wettable powder as 1-percent spray 25-percent wettable powder as drench—in 1½ pints of water per animal Emulsifiable material injected intramuscularly in rump.
III	Pills—orally 25-percent wettable powder as 1-percent spray
IV	Pills—orally 25-percent wettable powder as ¾-percent spray

for the control of the external parasite, *Dermatobia hominis*. Four separate formulations of Narlene were used. Some of them were used in only one or two of the trials; some were administered by different methods; two of them were used in all four trials. In a given trial each formulation that was used was administered to a designated lot. For each trial an untreated lot was used as a control.

Table 2 indicates the formulations that were used in each of the trials.

Dosages

For Trials I and IV the dosages were those prescribed by the company; they were all based on the weights of the animals. For Trials II and III dosages were increased somewhat. And for these trials the concentration of the spray with the wettable powder was increased from ¾ percent to 1 percent.

PROCEDURES

Allotment of Animals

Animals were selected so the lots would be as uniform as possible in size of animals, breed, age, and sex. In Trial IV the current nuche

Fig. 3. A typical example of a cow classified "Slight." She shows seven or eight nuche, but all are clustered in the small area of the side.

Fig. 4. A typical example of a cow classified "Moderate." She shows the cluster on her side with the several scattered nuche above the cluster.

infestation was considered so the lots might be uniform in this respect also.

Classification as to Degree of Infestation

An evaluation of the degree of infestation of each animal was made at the time of treatment and periodically as the counts of nuche were made. Men who were not familiar with the herd under study were delegated to make these evaluations. They worked independently and on the basis of their estimates of the degree of infestation assigned each animal to one of the following five classes: free, slight, moderate, heavy, very heavy.

For Trial IV the following guide was devised to assist the workers in thus classifying the animals:

Free—no nuche evident.

Slight—2 to 10 nuche over various parts of the body.

Moderate—1 medium-sized cluster and 2 to 10 other single nuche.

Heavy—various small or medium clusters and/or single nuche distributed in large numbers.

Very heavy—several large clusters and/or dense single nuche over large areas.

Admittedly, this procedure to classify the animals as to degree of infestation was not precise but some such procedure was necessary if the objectives of the study were to be accomplished. And the agreement among the men who did the work on a given occasion proved quite reassuring.

For Trials I, II, and IV three men did the classifying but in Trial III this duty was assigned to one man. Also in Trial III, each side of each animal was classified separately.

For purposes of calculations each man was instructed to assign a numerical score to each animal, or in Trial III to each side of each animal. The instruction was:

Free	90
Slight	70
Moderate	50
Heavy	30
Very heavy	10

Fig. 5. A typical example of a cow classified "Heavy." She shows the various clusters and several single nuche on the sides, throat, neck and brisket.

The Nuche Counts

At intervals after treatment in Trials I, II, and III counts were made of the nuche in one or more representative animals of each lot. The animals were selected at random except that any animal which

Fig. 6. A typical example of a cow classified "Very heavy". She shows several large clusters, even pouches of hide, and many single nuche.

had been previously counted and from which the nuche had been manually extracted was not used for a subsequent count.

For Trial IV, where the objective was to ascertain the effects of treatments on weight gains, regular counts were not made. However, after 3 months of this trial some of the control animals had become so heavily infested they were in critical condition. It was decided to extract the nuche manually from these animals; they showed 10 to 43 live nuche and numerous empty cysts.

An animal for the count was tied to a post in the corral then thrown and restrained. One or two men proceeded to examine the hide carefully and to extract all nuche. An enlargement within the hide was usually visible or could be detected by palpation. Frequently exudates were being expelled from the wounds. In this examination the empty cysts were counted.

RESULTS OBTAINED

To avoid repetition detailed results of the first two trials are not presented here. Objectives and procedures in all three trials were similar and the results were almost identical. Insofar as Trial IV involved somewhat different procedures and a different objective, results from it will be presented separately.

Fig. 7. Extracting the nuche. Note the cluster of white larvae being expelled from the small area. This Cebu bull yielded 266 nuche.

TABLE 3—Counts of nuche in Trial III

(Total nuche in two animals of each lot)

Lot	A	B	C
Treatment	None	Pills	Spray
At 22 days after treatment			
Nuche—dead.....	7	26	51
—alive.....	26	1	12
Percent mortality....	21.2	96.3	81.0
Empty cysts.....	3	28	15
At 52 days after treatment (*a*)			
Nuche—dead.....	4	31	10
—alive.....	14	2	3
Percent mortality....	22.2	93.9	76.9
Empty cysts.....	19	15	16
At 85 days after treatment (b)			
Nuche—dead.....	6	2	9
—alive.....	16	3	9
Percent mortality....	27.3	40.0	50.0
Empty cysts (*c*).....	?	?	?

(*a*) Only one animal each in lots A and C.
(b) Only one animal in lot B.
(c) Impossible to obtain valid count of empty cysts; they appeared numerous but were clustered in various areas; many were obscured by scab formations and scars.

In Trial III the formulations and dosages used were as follows:

Lot A. Control. No treatment.

Lot B. Pills. All exceeded 600 pounds and received maximum dosage of 1½ pills.

Lot C. The 25-percent wettable powder as 1-percent spray. Desired to use 2 quarts per animal; actually used average of 2¼ quarts.

Counts of Nuche

Results of the counts are shown in Table 3.

At the time of treatment in Trial III, January 31, all animals were classified. After 22 days two animals of each lot were counted and classified. Then for the second check after 52 days, it was planned to count two other animals of each lot, but before the work could be completed the steers—Cebú—stampeded and escaped from the corral. As noted in Table 3 only one animal each in lots A and C was counted and classified. The third count, 85 days after treatment, involved the steers in each lot that had not been previously counted. On that date all the steers were classified.

Discussion of Results of Counts

At the first count, 22 days after treatment, Lot B, which had received the pills, showed that 96.3 percent of the nuche had been killed. The mortality percentage for the sprayed lot was not quite so good, only 81.0 percent. But in the control lot, A, only 21.2 percent of the nuche were dead.

At the second count, 52 days after treatment, results were nearly identical with those of the earlier count. Both times the pills were more effective than the spray. Although not evident from Table 3, the count at 52 days revealed many small nuche but in nearly all cases in Lots B and C they were dead. At this count there was no evidence of reinfestation.

For the third count, at 85 days, reinfestation had occurred. Even in the treated lots the percentages of mortality were much lower than before. In all lots many small, live nuche were found. They were no more than 2 weeks old. It should be noted that the rainy season had set in about 3 weeks prior to the date of this third count.

From Table 3 it is observed that even the untreated animals of Lot A always showed some nuche that were dead. The explanation lies in the fact this larva is not hardy. It is carried superficially in the

hide and is easily killed by a slight bruise at the surface. By the same token it must be realized that all the mortality observed in the treated lots may not be due to the treatments.

It is not believed that the data on the numbers of empty cysts carry much significance. In most animals—treated and control—a palpation of the hide revealed perforations of the hide from which no material could be extracted. Such cases were recorded as empty cysts. Likely many of the cysts were not detected. And there was no way to decide whether the cyst resulted from the normal emergence of the larva in its cycle or from the disintegration of a larva which had been killed by a treatment.

Classifications as to Degree of Infestation

When the animals were treated in Trial III all of them were classified as to the degree of infestation of the nuche. At each of the three subsequent checks representative animals of each lot were again classified and scores were assigned for both sides of each animal. These results are shown in Table 4.

Discussion of Results From Classifications

The results from the classifications are essentially the same as those from the counts as shown in Table 3. At 22 days after treatment of the other lots, Lot A, which was untreated, showed a decline in scores, which signifies that an increase in infestation was evident. At the same time the improvement shown by lots B and C was quite spectacular.

At 52 days condition of the animal of Lot A was about the same as when the trial started. Probably the prolonged dry period that prevailed during this trial suppressed the nuche. At this same time lots B and C showed that the benefits of the treatments had persisted. The animals of both lots that were classified 52 days after treatment showed improvement. This advantage of the treated animals over lot A was evident as the steers were being rounded-up to the corral.

By the time of the third classification, at 85 days, the advantage of the treated lots over lot A was erased. The animals of all three lots showed about the same scores they had received 85 days previously.

TABLE 4—Classification as to degree of infestation

(Averages for the given sides of two animals in each lot)

Lot	A		B		C	
Treatment	None		Pills		Spray	
	Right sides	Left sides	Right sides	Left sides	Right sides	Left sides
	At 22 days after treatment					
When treated....	60	60	40	50	20	10
When classified...	40	50	80	70	70	70
Change.....	−20	−10	+40	+20	+50	+60
	At 52 days after treatment (*a*)					
When treated....	50	60	40	30	40	50
When classified...	50	70	60	80	60	80
Change.....	0	+10	+20	+50	+20	+30
	At 85 days after treatment (*b*)					
When treated....	50	50	50	70	50	60
When classified...	60	60	70	70	60	70
Change.....	+10	+10	+20	0	+10	+10

(*a*) Only one animal in Lot A.
(*b*) Only one animal in Lot B.

Results From Trial IV

Trial IV was designed to observe primarily the effects of treatments on gains in weight of animals on pasture. As indicated in Table 1, three lots of 14 animals each were used. They were young animals weighing about 430 pounds at the start of the trial. Steers and heifers were equally distributed among the three lots.

Classification as to Degree of Infestation

Throughout the trial all animals have been classified each month. Fig. 8 reveals the results that were obtained.

Discussion of Results from Classifications

Fig. 8 indicates that the animals of lot A, the control, declined in score from about 70 points down to 50. This signifies the infestation was becoming more serious in these untreated animals. And this occurred during a prolonged dry period when nuche are usually

retarded. By the second month even the treated animal in lots B and C had declined somewhat in scores. El Carmen, where this trial was conducted, lies at an elevation of 5,200 feet which is conducive to most serious nuche infestation. Evidently, at this elevation and with the dosages used the effectiveness of the treatments had subsided before the second month.

At the second month lots B and C were retreated. By the third month the scores on these animals were improved.

Gains in Weight

All animals in the trial were weighed at the start and again at monthly intervals. The weights are shown in Table 5.

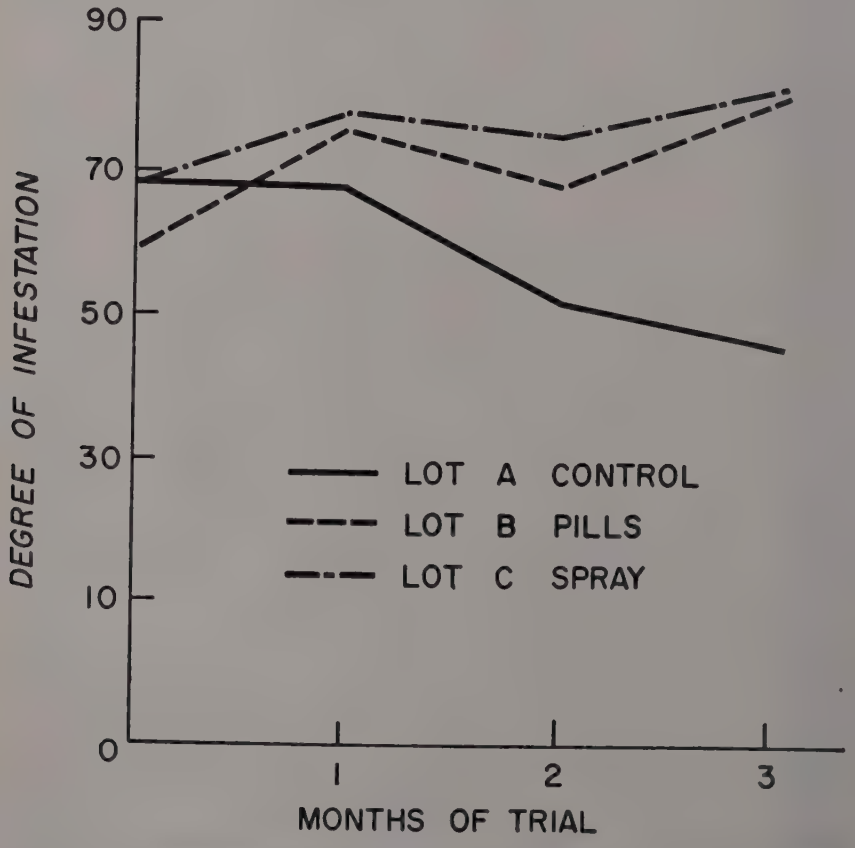

Fig. 8. Classification scores of the three lots in Trial IV made at monthly intervals. All 14 animals of each lot were scored each time.

TABLE 5—Average weights of animals in Trial IV—in pounds

Lot	A	B	C
Treatment	None	Pills	Spray
At start	430	449	415
At 1 month	436	454	432
At 2 months	429	447	419
At 3 months	438	470	439
Total gain	8	21	24

The average gains in weight for the animals in lots B and C are slightly higher than those for the untreated lot but the difference is not significant. The 3-month period covered by the trial was one of severe drought; pastures were very short; gains by the animals were only a fraction of the desired gains for the period. With all the animals thus reduced to a very low plane of nutrition it could hardly be anticipated that the treatments might exert benefits through increased gains.

CONCLUSIONS

1. The pills and the 25-percent wettable powder used as a 1-percent spray, at the dosages as used in Trials II and III, gave best results of the four formulations of Narlene that were studied.
2. A slight advantage was noted for the pills over the spray.
3. These formulations, as used in Trial III, afforded protection against the nuche for a period in excess of 52 days. The protection had diminished and some reinfestation was observed at 85 days following treatment.
4. Under climatic conditions such as those at La Ley, where Trial III was conducted, and at that elevation of about 2,200 feet, these two formulations can protect a herd if administered five or fewer times per year.
5. In Trial IV, which was conducted at El Carmen at an elevation of 5,200 feet, which is more favorable to nuche, these two formulations used in lower dosages afforded protection for only about 6 weeks.

6. It is not established that the two formulations as used in Trial IV resulted in gains in weight of young animals. Because of the extreme drought that prevailed while Trial IV was in progress and the consequent scarcity of pasture, none of the animals gained properly.
7. In Trials I and II where the 25-percent wettable powder was used both as a spray and a drench, the two methods of administration were equal in effectiveness.
8. When the emulsifiable, injectible material was used subcutaneously the results were better than when used intramuscularly. There are some practical problems involved in using this injectible material.
9. Of all the formulations that were used, the emulsifiable material as a ¾-percent spray as tried in Trial I proved least effective.

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Dr. Jorge Vera, DVM, veterinarian.
Dr. Raul Arbelaez, technical secretary.
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RESPONSES OF HEALTHY, RING SPOT-, AND YELLOWS VIRUS-INFECTED MONTMORENCY CHERRY TREES TO GIBBERELLIC ACID[1]

A PRELIMINARY REPORT

By *J. HULL, JR. and E. J. KLOS*[2]

RING SPOT AND YELLOWS are two of the most important virus diseases of sour cherries. The effects of ring spot have been conflicting as to yield and growth. However, yellows-propagated trees are reduced in growth and mature yellows-infected trees show a reduction in yield compared to healthy trees (Moore, 1946).

Cain and Parker (1951) tried to overcome the effects of the yellows virus with little success with 3-year annual applications of 5 and 15 pounds of ammonium sulfate per bearing tree. Klos used three times the normal amount of N, P, and K in a modified Hoagland's solution in a nutrient experiment on yellows-propagated trees with little growth increase.

To date, no treatment has been very successful in overcoming the stunting effect of yellows on propagated or bearing sour cherry trees.

Maramorosch (1957) overcame virus-caused stunting in sweet corn, china aster, and crimson clover with three weekly applications of gibberellic acid at 100 p.p.m. A preliminary study was made in the spring and summer of 1957 to determine the effect of gibberellic acid sprays on the growth of ring spot- and yellows-infected cherry trees. Although only a small number of trees were available for this investigation and no critical conclusions can be drawn, the results present some interesting indications.

[1] The gibberellic acid used in this investigation was the potassium salt of gibberellic acid, Gibrel, donated by Merck & Co., Rahway, N. J.

[2] Graduate student, department of horticulture, and assistant professor, department of botany and plant pathology.

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MATERIALS AND METHODS

Small 1-year old virus-free Montmorency trees were planted and grown under nutrient culture in 2-gallon crocks. They were placed on benches in the Michigan State University plant science greenhouses at East Lansing, Michigan. The plants were fertilized with a modification of Hoagland's nutrient solution.

Virus-free, yellows- or ring spot-infected buds were chip budded onto virus-free trees. The shoots that developed from these buds were used for this experiment, thus giving shoots that were either virus-free, infected with cherry yellows virus, or infected with ring spot virus.

Since this was a preliminary investigation of the effects of gibberellic acid on virus-infected cherry trees, a total of 17 trees was used. Eight trees were infected with ring spot, five with cherry yellows, and four were virus-free. Five of the ring spot-diseased and three of the yellows-infected trees were treated with gibberellic acid. Two of the virus-free trees received similar treatments. The different treatments were randomized on the greenhouse bench.

The trees were sprayed initially with gibberellic acid at the rate of 100 p.p.m. on May 7. The treatment was repeated on June 1 and at weekly intervals thereafter until the experiment was discontinued.

Measurements of shoot length and diameter were recorded weekly. The shoot diameter was measured with a caliper 6 inches above its point of origin from the inserted bud.

RESULTS

The effect of gibberellic acid on the shoot growth of virus-free cherry trees is shown in Fig. 1. The treated trees continued to elongate for 3 weeks after the controls had set their terminal buds.

The terminal growth of the trees infected with ring spot virus to gibberellic acid sprays was not as great as in the virus-free trees. Fig. 1 indicates that the treated trees produced more shoot growth than the non-treated trees, but the increase in terminal growth was very small.

The young shoots developing from the cherry yellows-diseased buds gave the most marked response to the spray applications (Fig. 1). The amount of shoot growth was about twice that of the non-treated yellows-infected trees. The stunting effect of the virus appeared to

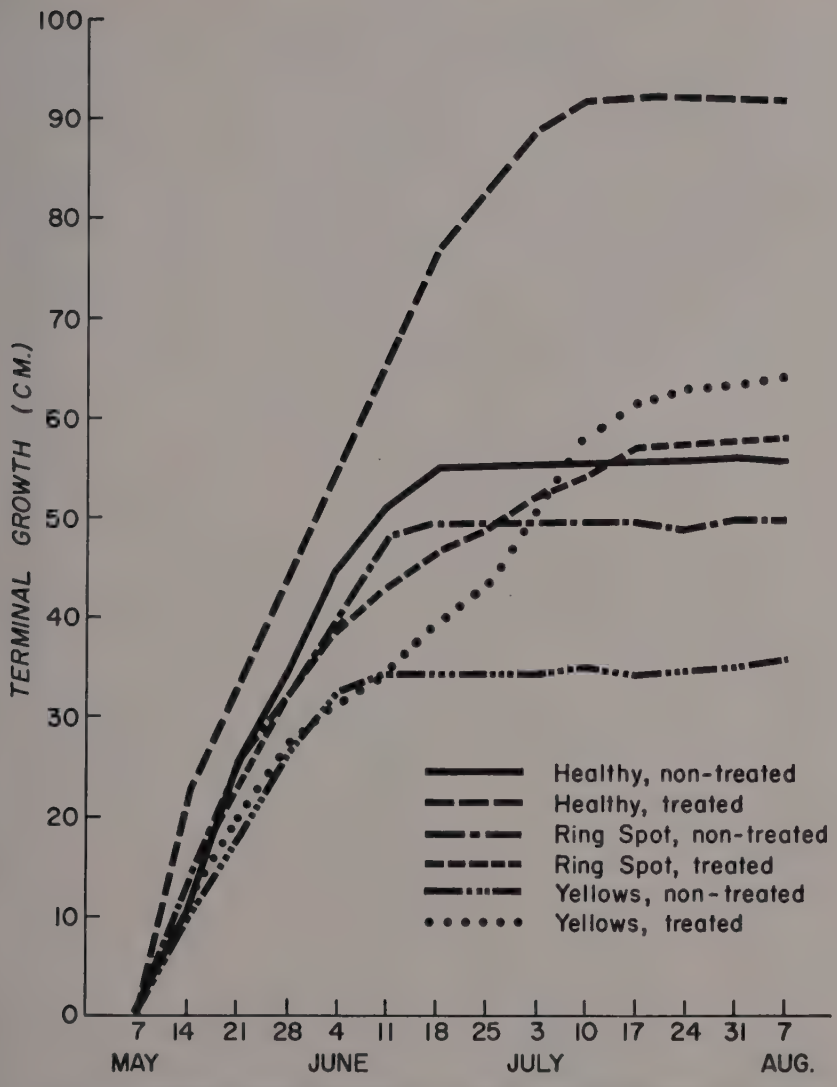

Fig. 1. Terminal growth cumulative weekly growth increments as influenced by foliar applications of gibberellic acid.

be partially overcome by the gibberellic acid treatment. The treated shoots produced about as much terminal growth as the non-treated virus-free trees.

In the non-treated trees, the terminal buds set between June 11 to 18. Growth continued until July 10 to 17 in the trees treated with

gibberellic acid. However, the terminal growth of the virus-infected trees was not as great as the non-treated virus-free trees. The greatest response in terms of shoot elongation was observed in the virus-free trees.

The total weekly increments of shoot diameters for all the treatments indicate a greater stem diameter for all trees receiving the gibberellic acid sprays (Fig. 2). The fluctuations in stem diameters in some treatments during the last 2 weeks of the experiment are the result of mite injury. Severe mite infestations, late in the experiment, defoliated some trees and dessication of the shoots resulted with decreases in the shoot diameter.

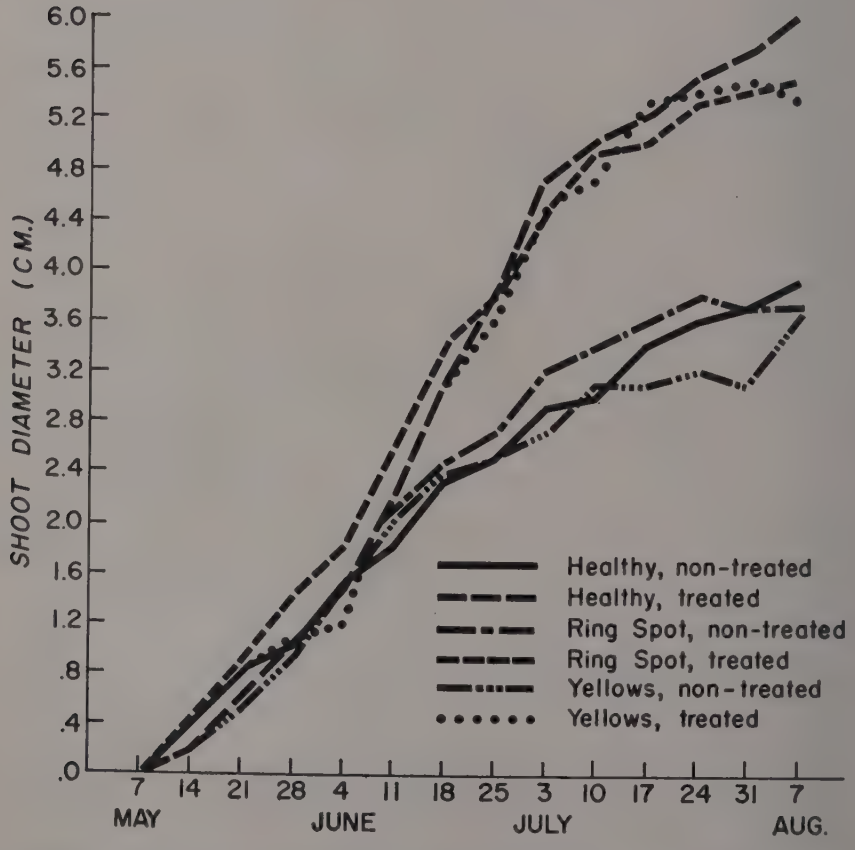

Fig. 2. Shoot diameter cumulative weekly growth increments as influenced by foliar applications of gibberellic acid.

SUMMARY AND CONCLUSIONS

Foliar applications of gibberellic acid at 100 p.p.m. were made on young Montmorency cherry shoots that were virus-free, infected with cherry yellows virus, or infected with ring spot virus. The treatments resulted in increased shoot length and diameter over the non-treated trees.

The number of trees included in each of the treatments was too small to make any valid conclusions concerning the response of these trees to gibberellic acid. However, the trend observed appears to be great enough to indicate that it may be possible to derive some value from such applications. Because cherry yellows is so prevalent and exerts a stunting effect on infected trees, gibberellic acid should be evaluated further as a possible remedy to some of the harmful virus effects.

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THE AUDIENCES FOR INFORMATION RELEASES BY THE MICHIGAN MARKETING INFORMATION AGENTS THROUGH NEWSPAPER, TELEVISION, AND RADIO[1]

By RAYMOND E. BORTON and JAMES D. SHAFFER

Department of Agricultural Economics

INTRODUCTION

Consumer marketing information programs are becoming a more important part of extension work throughout the country. Michigan's program employs 10 agents in 10 cities plus a state staff of three. New programs bring new questions and the need for more study of the how's, why's, and wherefore's of what the extension program is doing. To help the Michigan program and other similar programs, this study was undertaken to show to what extent consumers were aware of food marketing information released through the various mass media. From the study came a measure of the programs, audiences, and guideposts for improvement of future programs.

WHAT WE NEED TO KNOW

Consumer information programs can be successful only when they reach the consumer audience with the right information. In order to find out something of the nature of the audience for consumer information and of how they get their food information, this study of the consumer use of mass media for food information was undertaken. The questions asked were:

Through what media do consumers get their food information?

How do the different media compare in reaching the consumer audience with food information?

[1]Most of this report is based upon R. E. Borton's M.S. thesis (1957), "Consumer use of mass media for food information," Dept. of Agr. Econ., Mich. State Univ., East Lansing.

ARTICLE 41-3

To answer these questions the following were investigated:

1. The size of the audience—how many people are being reached and how many are available to be reached?
2. The preference of the audience—through which media do different consumers prefer to get their food marketing information?
3. The sources available to the audience—what means are now being used to get food marketing information to the consumer, and what is the potential of these means?

USE OF FINDINGS

Findings on this subject of consumer use of mass media for food information are being used to guide the Marketing Information for Consumers Program in Michigan. Differences in media used and effectiveness have indicated that more emphasis should be placed on certain methods of getting the message through. By subtracting some effort from one aspect of the program and concentrating more effort in another area, more efficient use of time, talent, and money is possible.

The experiences with surveys and questionnaires reported may be useful to others wishing to test the effectiveness of their efforts in this work. Anyone interested in using some of the same techniques will need to evaluate the costs and results in the light of his own problem, perhaps using the experiences gained in this study as a guide.

MUSKEGON PERSONAL INTERVIEW SURVEY

How the Survey was Made

Two types of surveys were used in this study. The first was a personal interview survey made during the first 3 weeks of September 1956. Interviews were conducted by graduate students in agricultural economics and the Muskegon Consumer Marketing Information agent. The sample was selected in a random manner from the Muskegon city directory. A total of 311 Muskegon homemakers were interviewed.

One of the purposes of the personal interview study was to attempt to find out what media the consumer looks to for food information. Each homemaker interviewed was asked about each of four media: television, radio, newspapers, and magazines. She was asked if she

used each one as a source of food information and then asked to indicate which was her most important single source of food information. To find out if they used the sources indicated homemakers were asked to give an example of information which they had used from one of the media.

This is what the homemakers in Muskegon said:

Television—Eighty-six percent of the homemakers interviewed said they had a television set. This is more than the national average of three out of five homes having television.[2]

When asked if they ever watched the homemaker television shows, 43 percent said, "yes." No particular time or show was specified in this question. They were just asked if they ever watched television shows dealing with homemakers' activities.

About 1 out of 10 homemakers interviewed said they watched homemaker shows of some kind frequently, and one-fourth reported that they watched them sometimes. Almost two-thirds did not watch during the day.

Radio—Of the group interviewed, 86 percent of the households reported having a radio. On a national scale the percentage is about the same—87 percent.[3] Comments such as "We gave our radio away when we got our television" might explain a few of the non-radio households. These figures do not count the people with radios in cars.

The homemakers were asked, "Do you ever listen to particular radio programs about food?" Seven percent of the respondents said "yes."

Newspaper—The coverage of newspapers in the Muskegon area is about 93 percent according to this survey. On a national scale there are 55 million daily newspapers sold which is an average of slightly more than one per family.[4]

When asked if they read the food page in the newspaper, 37 percent of the homemakers responded that they read them daily, another 44 percent read them sometimes, and only 15 percent said they never read them.

Magazines—"Do you read magazines for food information?" brought a "yes" response from three-fifths of the interviewees. Thirty-five percent said "no," and 4 percent did not answer.

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[2] "Television homes reach 35 million," Broadcasting and Telecasting, July 30, 1956, p. 36.
[3] "87 percent of U.S. homes use radio weekly," Broadcasting and Telecasting, July 23, 1956.
[4] "Circulation of U.S. dailies soars above 55 million," Editor and Publisher, Feb. 5, 1955, p. 78.

Characteristics of Media Audiences

A statistical test (Chi Square) was made to determine the likelihood that those homemakers who said they "watch TV food shows," "read the newspaper food page," or "read magazine food articles" were different in respect to age, education, and family income than those who said they did not. The only statistically significant difference found (using the 5 percent level), was between income and newspaper food page readership and between both education and income and readership of magazine food articles. The percent of homemakers reading magazine articles about food was directly related to education and ranged from 39 percent of those with a grade school education to 100 percent of those homemakers with some college education. A larger proportion of the middle income group said they read magazine food articles than was true of either the higher or lower income groups.

Media Most Helpful to Homemakers for Food Information

When the Muskegon homemakers were asked which media of the four mentioned (television, radio, newspaper, and magazines) was the most helpful to them as a source of food information, magazines were most frequently mentioned. Forty-one percent said magazines were the media they thought most helpful for food information. Newspapers were next with 29 percent. Television was the choice of 18 percent, and 2 percent listed radio as their most helpful media. A few homemakers mentioned more than one media, the most frequent combination being magazines and newspapers.

From these findings it appears that 7 out of 10 homemakers in Muskegon find the printed media most helpful for food information. The conclusion indicated is that the best way to get food information to consumers is through the newspapers and magazines. Two out of 10 find television most helpful while radio falls at the far bottom of the list. It would appear that these media are less acceptable to homemakers than the printed media as a means of reaching the mass audience in Muskegon with food information.

It should be noted, however, that the Consumer Marketing Information Programs deal in two different types of information and that the magazine would be a proper media for only one of these. Magazines could deal with information which does not have a local or immediate time reference. This could include general buying principles and information about grades and quality factors of particular

foods, new products, market developments and the like. However, much of the attention of these programs is focused on timely information about local market conditions—current prices, supplies, and qualities. The magazines do not appear adapted to disseminating this type of information.

TELEPHONE SURVEYS

How the Surveys were Made

Short answer questionnaires were designed with the help of each consumer agent to find out if consumers in each city were getting the information she was providing, and through which media they were reached. Each questionnaire asked about a specific news article, radio, or television program—did the respondent read article "X" in paper "Y" or did they hear Mr. "A" on program "B"? Calls were made as soon as possible after the program or after the distribution of the newspaper in order to aid recall. Questions on what was of particular interest were included to gain insight into the consumers interests.

Example of surveys—Lansing.

Television—agent appears as guest on Friday morning television food show. Survey calls were begun at 10:30 a.m. as soon as the program was completed and continued throughout the same day.

Newspaper—agent's weekly column appears in Thursday edition. Survey calls were made all day Friday.

Radio—agent is heard on both a weekly program and on spots used by a local disc jockey. Survey was conducted on day after weekly appearances. A spot announcement survey was included here.

On each media survey a goal of 300 calls was set but not always attained due to the difference in speed of the callers. A total of 11,193 calls were completed.

To test the validity of the calling after the completion of the radio and television programs instead of during the programs as in the commercial polls, some coincidental calls were made in Lansing.[5] No significant difference in the results was obtained between the coincidental and the recall surveys conducted on the same television program. Being able to use this after-the-program recall method is a great saving. If all the surveys had been done on a coincidental basis more than 500 callers would have been necessary while in actual practice

[5]A coincidental survey is one made during the time the program is on the air. The questions asked are such as, "Were you watching television just now? What station please? What is on?"

using the recall method only 69 callers were necessary for all the 12 cities. The cost of the telephone survey schedule, including tabulation, etc. was approximately 8 cents each. This compared with a cost of about $4.87 per schedule for the Muskegon personal interview survey. The telephone method appears to be the only method economically practical for checking on audiences for a large number of programs. It is sufficiently simple and inexpensive that it appears practical for individual agents to check their own audience ratings from time to time in order to evaluate the different media being used.

Newspaper—Table 1 summarizes the results of telephone surveys in eleven Michigan cities dealing with the readership of articles about food in newspapers. The first column shows the percent of families indicating they received the paper which included the weekly column of the local agent. The question was asked in terms of receiving a particular paper on a particular day. The range in such coverage was from 28 to 96 percent. The 28 percent was for Grand Rapids where the agent's column was carried only in the morning paper. The Detroit estimate is for the combination of the three major daily papers each of which carries a different column by the Detroit agent each week.

Based upon these data and estimated newspaper circulation a conservative estimate would be that newspapers including articles written by Michigan Consumer Information agents are received each week in

TABLE 1—Newspaper audiences for releases by Michigan Consumer Information agents, May 1957

City	Percent of families receiving paper(s) containing agents release	Percent of homemakers reading any food section articles week of survey	Percent of homemakers reading agent's column		Percent of homemakers reading any food page article who also read agent's column	Total sample
			Week of survey	Sometime		
Detroit(*a*)	94	55	36	56	65	415
Flint	92	36	14	46	39	287
Grand Rapids(*b*)	28	11	11	17	100	301
Kalamazoo	93	49	24	63	49	338
Lansing	93	50	36	56	72	151
Marquette	93	..	18	59	..	282
Muskegon	96	20	11	55	53	299
Pontiac	89	24	17	52	69	270
Royal Oak	44	24	16	30	68	255
Saginaw	88	48	21	50	44	276
Traverse City	86	..	33	67	..	206

(*a*) The Detroit information is based upon a survey made in Nov. 1957. The agent's releases appeared in each of the three major Detroit daily newspapers.
(*b*) The agent's column appeared only in the morning paper.

about two-thirds of the homes in Michigan. The combined circulation of the three Detroit papers alone was about 1.3 million and they probably reached about 800,000 different homes.

The second column shows the percent of the homemakers who said they read at least one article about food in the food section of the paper the week of the survey. Of those reporting getting the paper, about 45 percent reported reading at least one article about food. This did not include those taking the two papers which did not include a food section.

The percent of all homemakers contacted who indicated they read the agent's column the week of the survey varied among cities from 11 to 36 percent. The data indicate that the columns in the three Detroit papers alone are read by almost 300,000 homemakers each week.

Some of the homemakers said they did not read the article that week but had read the agent's column during previous weeks. The fourth column indicates the percent of homemakers who said they could remember having read the agent's column at any time. The range in coverage here was from 17 percent to 67 percent.

About 62 percent of the homemakers who said they read any articles about food said they read the one written by the Marketing Information agent. The range in this percentage among cities was from 39 to 100 percent.

One of the problems in audience surveys such as this involves the level of identification by the respondent. It is one thing to remember having read an article with such and such a title in a particular newspaper and quite another to name the column written by such and such an agent. There is also a problem of the respondents thinking they read an article when they actually had not. Because of a conflict in results in two surveys in Detroit believed due, primarily to differences in level of recall or identification required, a special survey was made of readership in Detroit.

This survey, made in November 1957, provided a more elaborate test of readership and a larger sample.

After determining which, if any, of the three Detroit daily papers the respondent took, the homemaker was asked to name the weekly column written by the Marketing agent. This required a more than casual knowledge of the articles. About 8 percent of all respondents named the column correctly. Another 10 percent came close to the correct title. Over 90 percent of these people said they had read the

column that week. Thus between 16 and 17 percent of all homemakers could name the column and said they had read it that week.

Many homemakers would, of course, read many articles without being able to recall the title of the column. Therefore, the next question named the column and asked if the homemaker had read it. For example, if the family took the **News** the homemaker was asked "Did you read the marketing column called 'Market Report' and headlined 'Chicken, Apples Still Best Buys' in the Thursday **News** this week?" Another 22 percent of those contacted indicated that they had read one or more of the articles during the week.

A check question followed this asking, "Can you remember anything about the article(s)? What?" Each interviewer had a copy of the column and was asked to evaluate whether the homemaker had actually read the article in question. According to the interviewer's evaluations, 69 percent had read the article, 9 percent had not, and 22 percent gave answers such that the interviewers could not tell. Adjusting for the bias on the basis of these answers would provide an estimate of between 15 and 20 percent. And combining the homemakers who could name the column with those who said they read it and could tell something about it provides an estimated weekly readership of at least 32 percent of the homemakers sampled. Others undoubtedly read the articles without identifying them with the name or author or without remembering the content.

The next question was asked of those who indicated they had not read one of the columns during the week of the survey. If they took the **Times,** for example, they were asked, "Have you read the 'Market Basket' column in any previous week?" An additional 23 percent of the homemakers contacted indicated that they had read one of the columns at one time or another.

The question was also followed by a check question asking what they remembered from the columns. The interviewers judged that 68 percent gave answers indicating they knew the nature of the column. The interviewers could not tell from the answers of the other 32 percent whether they had read the column or not. This indicated that at least 12 to 19 percent additional homemakers probably "read" the column "in a previous week."

One final question asked was, "Did you read the article titled 'Know Your Food Market' by Alice Boyts of Michigan State University in this week's paper?" Both the title and the name of the author were fictitious. The survey was introduced as one conducted by Michigan State

University. The interviewers were not told that this article did not exist. In other words, the question was purposely designed to encourage homemakers with a propensity to exaggerate the extent of her reading to indicate that she had read this article. A total of less than 7 percent of the homemakers contacted gave an affirmative answer to this question. A number of these were not a definite "yes" but rather were "maybe," "I think I might have" etc.

About 10 percent of those who said they read any food articles in the paper during the week of the survey also said they read the fictitious article.

About 6 percent of those who named one of the agent's columns also said they read the fictitious article.

Almost 12 percent of those who did not name the column, but said they had read it the week of the survey when the name was given, also said they read the fictitious article.

About 10 percent of those who said they had not read the agent's column "this week" but who had read it during a previous week also said they read the fictitious article.

There was no significant difference in the percentage reporting they had read the fictitious article and those giving the three types of answers to the check question (probably had read article, probably did not read article and could not tell) as evaluated by the interviewers.

If we were to assume over-response bias to be equal to the percentage who reported reading the fictitious article the revised readership estimates would be as follows:

About 35 percent of the homemakers read one or more of the three columns during the survey week.[6]

About 55 percent of the homemakers had read at least one of the three columns at some time and associated it with the title of the column or the title of the Consumer Marketing agent.

The only "check question" used for the other 10 city surveys was that of asking the respondents who said they had read an article to tell what information given was of particular interest to her. The telephone interviewer was asked to indicate the homemaker's answer and to judge whether the homemaker had actually read the release in question.

For the 10 cities an average of about 8 percent of those who said they had read the agent's article that week gave answers to the check

[6]This is arrived at by adjusting the 17 percent figure representing those who named the article and said they read it for a 6 percent overestimation bias and adjusting the 22 percent figure representing those who could not name the article, but who said they had read it when the title was suggested, for a 12 percent bias.

question which indicated that they probably were not properly identifying the column. An average of about 27 percent of those who said they had read the column of previous weeks gave doubtful answers to the check question.

Radio—Table 2 shows the percent of homemakers in each city who said they heard the agent's radio program the week of the survey and the percent who claimed to have ever heard the agent on radio. The audience ranged from 1 to 18 percent of the homemakers listening the week of the survey. In general, the ratings are very high for daytime radio listening.

TABLE 2—Radio audiences for releases by Michigan Consumer Information agents, May 1957

City	Percent of homemakers hearing program		Number in sample
	This week	Sometime	
Detroit	8	16	415
Flint	1	14	298
Grand Rapids	5	17	265
Kalamazoo	..	11	275
Lansing	..	17	207
Marquette	18	58	299
Muskegon	11	22	245
Saginaw	3	19	273
Traverse City	16	75	224

The highest ratings were received in the two smaller cities of the northern part of the state. In both cases a large proportion of the homemakers "know" the agent and are apparently more likely to listen to people they know.

The check question was also asked on the radio survey. An average of about 5 percent of the homemakers who said they heard the program the week of the survey gave answers indicating they were not properly identifying the program. An average of about 28 percent of those who reported hearing the agent previous weeks, but not during the survey week, gave doubtful answers.

Television—Table 3 shows, for each city with an agent on a television show, the percent of homemakers who reported they saw the show on which the agent appeared the week of the survey and the percent who said they had ever seen the agent on television. The percent of the

TABLE 3—Television audiences for releases by Michigan Consumer Information agents, May 1957

City	Percent of homemakers hearing program		Number in sample
	This week	Sometime	
Bay City	7	34	254
Grand Rapids	7	19	335
Kalamazoo	13	50	318
Lansing	7	40	234
Saginaw	4	26	285
Traverse City	10	66	224

homemakers viewing the show the week of the survey ranged from 7 to 13 percent. These ratings appear very good considering the daytime viewing pattern in general.

The percent of homemakers who remembered ever having seen the agent on television ranged from 19 to 66 percent. The high again was for one of the small northern cities.

An average for the cities of about 10 percent of the homemakers who said they had viewed the agent on television the week of the survey gave answers to the check question indicating they probably were not properly identifying the program. An average of about 23 percent of those reporting seeing the agent previous weeks, but not during the survey week, gave doubtful answers.

Total Audience—It is very difficult to determine total non-duplicated audiences to the releases from a particular program. Table 4 gives an estimate of the percent of homemakers who had been contacted by the local agent through at least one of the media at some time. The questions dealt only with the programs or articles by the local agent in the particular city. Obviously persons outside the originating city are contacted and homemakers in one of the cities hear programs or read articles prepared by agents in some of the other cities. Table 4 presents only an estimate of the percent of homemakers who thought they had heard or read a release of the particular agent by the media tested. The media tested for each city is also indicated in Table 4.

A rather high degree of familiarity is required to identify the author of a newspaper article or the performer on a radio or television program. Undoubtedly, a number of homemakers had had such contacts without identifying them with the agent's name or title. Against

this must be considered the inevitable over estimation resulting from people trying to give the "right" answer. On the whole it is believed that these represent reasonably reliable estimates of the percent of homemakers contacted.

It should not be inferred from this report that these surveys cover all of the activities or audience of a particular agent. In practice the agents prepare materials which are released to the public without being identified by their name or title. Frequently, material is prepared for presentation by other people. Information is also presented by other means than the specific media releases or programs considered in these surveys.

TABLE 4—Estimated non-duplicated audiences contacted by Michigan Consumer Information agents by combined media as of May 1957

City	Percent of homemakers who said they read, heard, or viewed some release at some time	Media included in survey			Number in sample
		Newspaper	Radio	Television	
Bay City	42			X	254
Detroit	60	X	X		415
Flint	49	X	X		585
Grand Rapids	26	X	X	X	901
Kalamazoo	69	X	X	X	931
Lansing	60	X	X	X	760
Marquette	72	X	X		581
Muskegon	62	X	X		544
Pontiac	52	X			270
Royal Oak	30	X			255
Saginaw	51	X	X	X	834
Traverse City	83	X	X	X	654

X Indicate media surveyed in each city.

Is the Information Useful?—One of the questions asked of all those homemakers who said they had read, heard, or seen a release by one of the agents was whether they found the information useful. Of these homemakers, 71 percent said the information was useful. There was little difference in the response depending upon the media. About 70 percent who said they read a newspaper release also said it was useful as did 75 percent of the television viewers and 71 percent of the radio listeners.

CONCLUSIONS

As might be expected, the consumer use of mass media for food information varies a great deal among cities surveyed. Some general statements can be made which are of interest to all. Details of each survey have been made available to each local community in mimeographed form through the local agent.[7]

Generally, the telephone surveys showed between one-half and two-thirds of the consumers in each area had been reached by the MIC Program at some time by all the media combined. Somewhat less than one-third had been reached during the week of the telephone survey (late April and early May 1957).

Newspapers were outstanding in reaching consumers with food information. More than one-half of the consumers in eight of the eleven newspaper surveys had read the agent's article at some time. During the survey week, program information reached twice as large a proportion of the consumers through the newspapers as by either radio or television. During the survey week the newspaper reached as many or more people than either radio or television in every city tested.

It would also appear that the practical potential for expanding the audience in most of the cities is greater by newspaper than by the other media. One of the reasons for this is that the newspaper may be read at the homemaker's convenience, whereas the radio and television programs are available to the homemaker for but a few minutes each week with little regard to the homemaker's convenience. A change in basic listening or viewing habits would be necessary to greatly expand radio or television audiences. For the five cities with releases through all three media, over 85 percent of the total audience was reached by newspaper.

One-fifth to two-thirds of the homemakers reported having seen the MIC agent on television at some time. Radio contacts ranged from 1 to 8 percent on a weekly basis. In one city 75 percent of the homemakers had heard the agent on the radio at some time.

The personal interview surveys showed homemakers prefer the printed media (magazines and newspapers) to radio and television as a source of food information.

Homemakers with the most education and those in the average income bracket looked to magazines more than those in lower education and other income brackets.

[7]A limited number of these mimeographed reports are available from the Department of Agricultural Economics, Mich. State Univ.

FREQUENCY OF PURCHASE OF MAJOR FRESH, FROZEN, AND CANNED FRUITS AND VEGETABLES

M.S.U. CONSUMER PANEL, 1955-56[1]

By JAMES D. SHAFFER
DEPARTMENT OF AGRICULTURAL ECONOMICS

TABLE 1 IS A TABULATION of the frequency of purchase of about 150 items of fresh, frozen, and canned fruits and vegetables. The first column indicates the percent of families buying none of each product. The following 10 columns show the percent of families buying each product various numbers of weeks out of the year. The final two columns indicate the average number of weeks out of the year each product was purchased per family and per family buying. The products are arranged in six groups—fresh fruits, fresh vegetables, frozen fruits, etc. Within each group the products are listed or ranked in order of the percent of families buying.

For example, the first line of the table indicates that bananas were purchased by 94 percent of all families—more than any other fresh fruit. About 27 percent of the families purchased them more than 30 weeks out of the year. The total of all families purchased bananas an average of about 21 times during the year. Families buying bananas bought them an average of about 22 times during the year. By comparison apples were purchased by about as many families as bananas but were purchased much less frequently.

The data are based upon the weekly reports of the families of the M.S.U. Consumer Panel who reported 50 or more weeks out of the year in 1955 and 1956. The number of families included was 211 in 1955 and 226 in 1956. These families completed diaries of all food obtained for home consumption during the year.

The data are limited to actual purchases and do not include acquisitions by other means such as from the home garden or as gifts.

[1]Mich. State Univ. Consumer Panel Report No. 50. The M.S.U. Consumer Panel is operated under the direction of G. G. Quackenbush.

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TABLE 1—Frequency of purchases of major fresh, frozen, and canned fruits—fresh, frozen, and canned vegetables, M.S.U. Consumer Panel families reporting 50 weeks or more. Average of 1955 and 1956

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family each year	Average number of weeks purchases were made per family buying each year
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-54		
FRESH FRUITS													
Bananas	6	2	1	1	2	4	10	28	19	16	11	20.9	22.1
Apples	7	4	2	6	2	6	25	34	10	3	1	11.9	12.9
Oranges	11	8	8	6	8	6	18	20	8	4	3	9.9	11.2
Peaches	17	18	12	10	11	7	20	5	0	0	0	3.6	4.3
Grapefruit	18	12	8	6	4	6	17	18	9	2	0	7.7	9.5
Cantaloupe and muskmelon	19	14	10	11	6	7	23	10	0	0	0	4.4	5.5
Grapes	20	16	9	8	7	10	20	8	2	0	0	4.5	5.6
Strawberries	24	12	14	11	12	7	18	2	0	0	0	3.1	4.1
Lemons	30	16	10	9	8	7	13	6	1	0	0	3.5	5.0
Watermelon	42	18	12	7	7	5	8	1	0	0	0	2.0	3.4
Tangerines	44	23	12	6	6	4	4	1	0	0	0	1.6	2.8
Cranberries	52	20	14	6	4	2	2	0	0	0	0	1.1	2.3
Blueberries	54	15	9	6	4	6	6	0	0	0	0	1.4	3.0
Pears	56	20	11	6	2	0	3	2	0	0	0	1.2	2.8
Plums	56	20	9	6	3	2	4	0	0	0	0	1.1	2.4
Raspberries	58	21	12	4	4	1	0	0	0	0	0	1.0	1.9
Pineapple	76	14	6	3	0	0	1	0	0	0	0	.5	1.9
Sweet cherries	80	16	2	2	0	0	0	0	0	0	0	.3	1.6
Avocadoes	85	8	1	1	2	1	2	0	0	0	0	.5	3.4
Rhubarb	85	9	3	1	2	0	0	0	0	0	0	.3	1.9
Orange juice	88	8	0	0	0	0	1	1	1	1	0	.8	6.6
Sour cherries	90	8	2	0	0	0	0	0	0	0	0	.1	1.2
Apricots	92	6	1	1	0	0	0	0	0	0	0	.1	1.4

Limes	91	8	1	0	0	0	0	0	0	0	0	.1	1.3
Dewberries and blackberries	93	6	1	0	0	0	0	0	0	0	0	.1	1.3
Nectarines	96	3	1	0	0	0	0	0	0	0	0	.0	1.0
Orange drink(*a*)	96	3	1	0	0	0	0	0	0	0	0	.0	1.0
FRESH VEGETABLES													
Head lettuce	5	1	1	2	3	0	10	25	26	13	14	22.5	23.8
Celery	6	4	3	5	5	5	26	27	14	3	2	18.0	13.0
Carrots	7	3	5	7	6	4	28	27	10	2	1	11.0	11.0
Mature onions	9	3	4	8	7	10	32	23	3	0	1	8.0	8.8
Tomatoes	10	6	7	6	6	5	23	26	8	2	1	9.5	10.6
Michigan potatoes	11	8	6	7	8	8	27	19	5	1	0	7.6	8.5
Cabbage	13	7	7	8	6	6	23	24	4	1	1	8.1	9.4
Corn	25	21	14	9	7	6	14	4	0	0	0	3.0	4.0
Cucumbers	28	11	9	8	5	5	17	14	2	1	0	5.2	7.3
Peppers	28	12	8	8	6	4	17	14	2	1	0	5.0	6.9
Radishes	30	16	10	7	5	5	15	10	2	0	0	4.2	6.0
California potatoes	34	20	17	8	9	4	7	1	0	0	0	2.0	3.0
Squash	37	17	12	8	4	7	12	3	0	0	0	2.5	3.9
Potatoes—state unknown	37	23	13	8	5	4	7	2	1	0	0	2.1	3.4
Cauliflower	44	17	12	8	6	2	8	2	1	0	0	2.1	3.7
Green onions	44	14	8	6	4	3	12	8	1	0	0	3.2	5.7
Idaho potatoes	45	17	11	5	3	5	10	4	0	0	0	2.2	4.1
Sweet potatoes and yams	46	19	13	7	3	4	7	1	0	0	0	1.7	3.0
Potatoes grown in other states	48	24	14	5	4	2	3	0	0	0	0	1.2	2.3
Asparagus	51	16	9	7	5	3	8	1	0	0	0	1.6	3.3
Maine potatoes	52	20	9	8	4	1	6	0	0	0	0	1.3	2.8
Turnips and rutabagas	60	14	9	5	4	2	4	2	0	0	0	1.2	3.1
Snap beans	61	16	7	5	2	2	6	1	0	0	0	1.2	3.2
Parsnips	72	14	6	2	3	1	2	0	0	0	0	.7	2.5
Celery cabbage	69	21	6	1	1	1	1	0	0	0	0	.6	1.7
Spinach	73	8	6	2	2	1	4	3	1	0	0	.4	4.9
Leaf lettuce	75	14	3	2	1	1	3	1	0	0	0	.9	3.5
Mixed leafy vegetables	79	13	6	1	0	0	2	1	0	0	0	.6	2.9

(*a*) Based upon 1956 data only.

TABLE 1—Continued

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family each year	Average number of weeks purchases were made per family buying each year
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-54		
FRESH VEGETABLES (Cont'd)													
Broccoli	78	10	4	4	1	1	1	1	0	0	0	.7	3.2
Brussel sprouts	84	8	3	2	2	0	1	0	0	0	0	.4	2.3
Parsley, swiss chard, water cress	84	8	4	2	1	0	1	0	0	0	0	.3	2.2
Endive, chicory, escarole	86	9	1	1	0	1	1	1	0	0	0	.4	3.0
Beets	87	8	3	2	0	0	0	0	0	0	0	.2	1.7
Greens, beets, etc	89	8	2	0	2	0	1	0	0	0	0	.2	1.8
Peas—in pod	89	6	3	1	0	0	1	0	0	0	0	.2	2.0
Egg plant	90	7	2	0	0	0	1	0	0	0	0	.3	2.6
Pumpkin	92	8	0	0	0	0	0	0	0	0	0	.1	1.1
Other leafy vegetables	95	4	1	0	0	0	0	0	0	0	0	.1	1.6
Artichokes	97	2	1	0	0	0	0	0	0	0	0	.0	1.3
Beans—lima in pod	98	2	0	0	0	0	0	0	0	0	0	.0	1.2
Mixed green and yellow vegetables	98	2	0	0	0	0	0	0	0	0	0	.0	.8
Peas	98	2	0	0	0	0	0	0	0	0	0	.0	.8
Beans—lima, shelled	98	2	0	0	0	0	0	0	0	0	0	.0	2.0
FROZEN FRUITS													
Orange juice	24	9	7	4	3	2	10	16	10	6	9	12.8	16.8
Strawberries	36	16	12	8	6	6	11	4	1	0	0	3.0	4.7
Lemonade	59	15	9	5	3	2	5	2	0	0	0	1.4	3.3
Grape juice	76	10	6	2	1	1	3	1	0	0	0	.9	3.6
Grapefruit juice	77	12	4	2	2	1	2	0	0	0	0	.6	2.8

Raspberries	79	11	4	3	1	1	1	0	0	0	0	.5	2.1
Lemon juice	81	12	3	2	1	0	1	0	0	0	0	.4	2.0
Pineapple juice	85	11	2	1	0	0	1	0	0	0	0	.3	1.8
Limeade base(*a*)	89	8	1	1	1	0	0	0	0	0	0	.2	1.6
Sour cherries	90	6	2	1	0	0	0	1	0	0	0	.3	2.8
Lime juice	91	7	1	1	0	0	0	0	0	0	0	.2	1.6
Pineapple	91	7	1	0	1	0	0	0	0	0	0	.1	1.6
Mixed citrus juice	92	6	1	0	0	0	1	0	0	0	0	.2	1.9
Grapefruit	93	4	1	1	0	0	1	0	0	0	0	.2	2.4
Tangerine juice	93	5	1	0	0	0	0	1	0	0	0	.2	3.0
Peaches	95	4	1	0	0	0	0	0	0	0	0	.1	1.4
Rhubarb	96	3	1	0	0	0	0	0	0	0	0	.1	1.3
Cranberry	96	3	0	0	0	1	0	0	0	0	0	.1	1.3
Other melons	96	3	1	0	0	0	0	0	0	0	0	.1	1.3
Cantaloupe and muskmelon	96	4	0	0	0	0	0	0	0	0	0	.0	1.1
FROZEN VEGETABLES													
Peas	48	14	6	6	4	3	10	8	0	1	0	2.8	5.4
Broccoli	63	12	6	4	4	1	6	3	1	0	0	1.7	4.7
French fried potatoes	70	12	4	3	2	1	3	4	1	0	0	1.5	5.1
Squash	70	12	6	3	2	2	4	1	0	0	0	1.0	3.3
Snap beans	72	10	5	4	2	1	4	2	0	0	0	1.2	4.3
Mixed green and yellow vegetables	72	13	6	2	2	2	2	1	0	0	0	.8	2.8
Spinach	74	12	5	2	2	1	2	2	0	0	0	.8	3.0
Brussel sprouts	76	12	4	2	1	1	3	1	0	0	0	.7	2.9
Lima beans	77	10	4	2	1	1	2	3	0	0	0	1.1	4.6
Sweet corn	78	13	3	3	1	0	1	1	0	0	0	.7	3.0
Cauliflower	80	10	3	1	2	0	3	1	0	0	0	.8	3.7
Asparagus	80	13	4	0	0	1	1	1	0	0	0	.5	2.3
Mixed vegetables	89	8	2	1	0	0	0	0	0	0	0	.2	1.9
Mashed potatoes or patties(*a*)	92	6	1	1	0	0	0	0	0	0	0	.1	1.4
Sweet potatoes or yams	94	5	1	0	0	0	0	0	0	0	0	.1	1.5

(*a*) Based upon 1956 data only.

TABLE 1—Continued

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family each year	Average number of weeks purchases were made per family buying each year
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-54		
CANNED FRUITS													
Pineapple	13	10	8	8	5	9	26	18	2	1	0	6.6	7.5
Olives	24	18	12	10	7	7	15	7	0	0	0	3.9	5.1
Fruit cocktail	34	16	11	10	4	5	12	7	1	0	0	3.4	5.1
Peaches	36	9	9	6	6	6	14	10	3	1	0	4.7	7.3
Apple sauce and apple butter	38	17	11	8	5	4	11	5	1	0	0	2.8	4.5
Pears	43	16	7	4	6	4	13	7	0	0	0	2.9	5.1
Maraschino cherries	52	23	10	8	3	2	2	0	0	0	0	1.0	2.1
Apricots	54	14	11	4	4	3	6	4	0	0	0	1.8	4.0
Cranberries	57	26	9	4	2	0	2	0	0	0	0	.8	1.9
Pineapple juice	57	18	7	3	3	3	6	3	0	0	0	1.6	3.7
Sour cherries	60	16	8	4	4	1	5	1	1	0	0	1.3	3.4
Grapefruit	61	14	7	3	3	2	5	4	1	0	0	2.1	5.3
Single strength orange juice	62	14	7	4	3	1	4	4	1	0	0	1.9	5.2
Apple cider	68	19	6	4	1	1	1	0	0	0	0	.6	1.9
Single strength grape juice	68	15	6	3	2	0	4	1	1	0	0	1.3	4.1
Plums	70	13	7	3	2	2	2	1	0	0	0	.8	2.8
Sweet cherries	70	14	5	4	3	1	3	0	0	0	0	.8	2.7
Single strength grapefruit juice	70	15	5	3	3	1	2	1	0	0	0	1.1	3.6
Prune juice	72	9	6	2	2	1	4	2	1	1	0	1.6	5.7
Blueberries	74	13	5	3	2	1	1	1	0	0	0	.6	2.4
Apples	75	13	6	2	1	1	1	1	0	0	0	.6	2.3
Single strength lemon juice	76	14	5	2	2	1	0	0	0	0	0	.5	2.0
Mixed fruit juices	77	12	6	2	1	0	1	1	0	0	0	.6	2.5

Orange drink(a)	77	11	3	3	1	1	2	1	1	0	0	.9	3.7
Apple juice	80	11	4	0	0	1	2	2	0	0	0	.7	3.7
Fruit pickles	80	11	4	3	1	0	1	0	0	0	0	.5	2.4
Mixed citrus juices	81	11	2	2	0	0	3	1	0	0	0	.6	3.1
Apricot nectar	83	9	2	2	0	0	2	2	0	0	0	.6	3.7
Mixed fruit—except citrus	84	11	3	1	0	0	1	0	0	0	0	.3	1.8
Concentrated orange juice	86	8	3	2	0	1	0	0	0	0	0	.3	2.0
Mixed citrus fruit	86	9	3	1	0	1	0	0	0	0	0	.3	2.3
Prunes	87	7	2	1	1	0	2	0	0	0	0	.3	2.6
Hawaiian punch base	88	6	2	0	2	0	1	0	0	0	0	.3	2.5
Concentrated lemon juice	90	8	2	0	0	0	0	0	0	0	0	.2	1.5
Orangeade and orange base	91	6	2	0	0	0	0	0	0	0	0	.2	2.4
Figs	92	6	1	0	0	0	0	1	0	0	0	.2	2.6
Oranges	92	5	1	1	1	0	0	0	0	0	0	.2	3.0
Lemonade	92	7	1	0	0	0	0	0	0	0	0	.1	1.2
Raspberries	93	6	1	0	0	0	0	0	0	0	0	.1	1.9
Tangerine juice	94	4	2	0	0	0	0	0	0	0	0	.2	3.5
Concentrated grape juice	96	3	1	0	0	0	0	0	0	0	0	.1	1.8
Strawberries and blackberries	96	3	1	0	0	0	0	0	0	0	0	.1	1.6
CANNED VEGETABLES													
Tomato catsup and sauces	16	9	8	7	7	7	19	20	7	0	0	7.5	9.0
Peas	17	9	9	8	5	6	24	17	4	1	0	6.6	8.0
Corn	18	11	7	7	9	5	19	19	4	1	0	6.6	8.0
Cucumber pickles	20	9	9	7	8	7	21	14	4	1	0	5.9	7.4
Beans—navy, baked, white	25	16	9	9	6	4	16	12	2	1	0	4.9	6.5
Snap beans	28	9	8	6	5	4	20	16	4	0	0	6.0	8.3
Kidney beans	33	16	10	10	7	3	15	5	1	0	0	3.3	5.0
Pumpkin	42	30	12	7	5	2	2	0	0	0	0	1.3	2.2
Beets	43	14	11	5	5	5	13	4	0	0	0	2.6	4.5
Lima beans	48	18	10	7	5	3	6	3	0	0	0	1.8	3.5
Tomato juice	49	14	8	6	4	2	10	4	1	2	0	3.0	5.9
Sauerkraut	52	17	8	9	3	4	5	2	0	0	0	1.7	3.4

(a) Based upon 1956 data only.

TABLE 1—Concluded

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family each year	Average number of weeks purchases were made per family buying each year
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-54		
CANNED VEGETABLES (Cont'd)													
Tomatoes	52	14	7	4	2	4	8	8	1	0	0	2.7	5.5
Asparagus	53	15	7	6	4	2	8	4	1	0	0	2.1	4.6
Mushrooms	53	14	8	6	4	2	10	3	0	0	0	2.0	4.3
Relish(*a*)	54	16	8	7	4	2	7	2	0	0	0	1.5	3.4
Horse radish	58	16	10	7	4	1	4	0	0	0	0	1.1	2.7
Spinach	66	10	6	4	4	2	6	2	0	0	0	1.4	4.2
Sweet potatoes and yams	66	15	8	2	4	1	3	1	0	0	0	.9	2.8
Potatoes	67	14	5	4	2	2	4	2	0	0	0	1.2	3.7
Bean sprouts	68	15	8	4	2	1	1	1	0	0	0	.8	2.4
Mixed green and yellow vegetables	69	15	7	4	2	0	2	1	0	0	0	.8	2.6
Mixed vegetable juice	77	10	4	2	1	1	3	2	0	0	0	.9	4.1
Chop suey, chow mein	80	9	4	3	1	1	2	0	0	0	0	.6	2.9
Mixed vegetables	81	12	4	2	1	0	0	0	0	0	0	.3	1.6
Pimentos(*a*)	84	11	1	2	1	0	1	0	0	0	0	.3	2.0
Carrots	85	7	5	1	0	1	1	0	0	0	0	.3	2.0
Mature onions	88	9	3	0	0	0	0	0	0	0	0	.2	1.5

(*a*) Based upon 1956 data only.

FREQUENCY OF PURCHASE OF PARTICULAR ITEMS OF MEAT, POULTRY, AND FISH

M.S.U. CONSUMER PANEL, 1956[1]

By JAMES D. SHAFFER

DEPARTMENT OF AGRICULTURAL ECONOMICS

HOW MANY FAMILIES bought no spareribs during the entire year? How many bought lamb and mutton more than five times during the year? Which meat items were purchased by the largest percent of families? How many weeks out of the year did the average family buy chuck roast? How many weeks out of the year did they buy veal steak?

The following table answers these questions for more than 100 items of meat, poultry, and fish. The data are based upon the weekly reports of 226 families of the Michigan State University Consumer Panel who reported 50 or more weeks during 1956. These families completed diaries of all food obtained for home consumption during the year.

The first section of the table shows the percent of families obtaining each item various numbers of weeks out of the year. In the first line, for example, the data indicate that 99 percent of the families purchased some kind of beef 11 or more weeks out of the year.[2] The last two columns of the table show the number of weeks the average of all families purchased each item and the number of weeks the average of all families buying, purchased each item. For example, the second line of the table shows that on the average, all families made but .1 purchases of wholesale beef during the year but that the families buying wholesale beef bought it an average of 1.4 times during the year.

The data include a limited number of acquisitions which were not

[1]M.S.U. Consumer Panel Report No. 49. The M.S.U. Consumer Panel is operated under the direction of G. G. Quackenbush.

[2]The percentage figures are to the nearest full percent. Actually two families bought no beef at all but since two is less than one-half of 1 percent of the families, it did not show up in the table.

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purchases. It includes acquisitions from hunting and fishing and from gifts. However these are of very little importance except for a very few items. Acquisitions by means other than direct expenditure is estimated to amount to about 3½ percent of all purchases of the items included in the table. The three items, "venison and other game animals," "game birds," and "other fish" includes a very large proportion of acquisition by means of hunting and fishing. An estimated 20 percent of the turkey is obtained as gifts. The only other items involving any significant number of acquisitions as gifts were chicken and ham.[3]

[3]For a discussion of the extent of acquisitions of food by means other than purchase see Quackenbush, G. G. (1958). Market value of non-expenditure foods obtained by gifts, home grown, and hunting and fishing. Pages 219-224 of this publication.

TABLE 1—Frequency of purchases of particular items of meat, poultry, and fish by 226 M.S.U. Consumer Panel families during 1956

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family	Average number of weeks purchases were made per family buying
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-52		
BEEF	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**6**	**13**	**19**	**61**	**39.7**	**40.0**
Wholesale cuts	93	5	2	0	0	0	0	0	0	0	0	.1	1.4
Canned	68	16	8	3	2	0	3	0	0	0	0	.9	2.7
Corned	52	23	7	4	5	4	4	1	0	0	0	1.5	3.1
Chipped	42	23	9	7	3	3	8	4	1	0	0	2.7	4.7
Ground hamburger	2	4	3	3	3	1	12	16	20	21	15	23.5	23.9
Ground round steak—Lean ground beef	27	15	7	8	8	4	7	13	5	4	2	7.2	9.8
Beef liver and baby beef liver	45	15	12	8	3	4	9	3	1	0	0	2.4	4.3
Heart, tongue, and other organ parts	79	14	4	2	1	0	0	0	0	0	0	.4	1.8
Chuck roast	12	8	6	8	8	6	26	20	4	2	0	7.9	9.0
Rib roast													
(bone out)	82	12	3	1	1	1	0	0	0	0	0	.4	1.8
(bone in)	60	19	9	6	2	1	2	1	0	0	0	1.0	2.6
Other roast													
(bone out)	52	21	8	4	3	2	8	2	0	0	0	1.6	3.2
(bone in)	40	31	11	5	3	2	5	2	1	0	0	2.0	3.4
Round and swiss steak	11	14	7	11	8	6	21	18	4	0	0	6.7	7.6
Sirloin steak	28	19	9	5	6	5	12	9	3	2	2	5.3	7.3
Porterhouse and T-bone steak	36	19	9	8	5	4	11	7	1	0	0	3.1	4.8
Other steak	16	11	12	9	8	4	21	15	3	1	0	6.1	7.2
Stewing beef	47	19	11	6	4	3	8	1	1	0	0	2.0	3.8
Boiling beef or short ribs	51	18	9	8	2	3	6	3	0	0	0	1.8	3.7
All other beef	49	26	8	4	3	3	4	3	0	0	0	1.5	2.9

TABLE 1—Continued

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family	Average number of weeks purchases were made per family buying
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-52		
PORK	**0**	**2**	**0**	**0**	**0**	**0**	**3**	**9**	**21**	**22**	**43**	**34.6**	**34.7**
Wholesale cuts	96	4	0	0	0	0	0	0	0	0	0	.1	1.0
Bacon	2	2	4	2	2	5	19	30	18	11	5	17.5	17.8
Canadian bacon	59	15	10	5	3	3	3	2	0	0	0	1.3	3.2
Canned pork	90	7	3	0	0	0	0	0	0	0	0	.2	1.7
Pork chops	9	3	5	5	7	5	24	28	12	2	0	10.9	11.9
Pork steaks	34	18	9	11	7	7	7	7	0	0	0	2.9	4.4
Ham—Center slice	45	15	12	6	5	3	8	5	1	0	0	2.7	4.8
Ham—Whole/half													
(bone out)	71	15	8	2	2	0	2	0	0	0	0	.6	2.0
(bone in)	36	21	13	11	8	3	6	2	0	0	0	1.9	3.0
Canned ham	70	18	5	2	3	1	1	0	0	0	0	.7	2.1
Other ham													
(bone out)	41	21	16	7	4	2	8	1	0	0	0	1.8	3.0
(bone in)	67	18	10	3	1	0	1	0	0	0	0	.6	1.8
Picnic ham—Cured butts	47	15	11	8	4	4	8	3	0	0	0	1.9	3.6
Pork liver	67	10	8	5	2	2	5	1	0	0	0	1.2	3.6
Heart, tongue,													
and other organ parts	87	7	2	3	1	0	0	0	0	0	0	.3	2.1
Roast	21	14	7	9	10	8	19	10	0	1	1	4.9	6.1
Sausage links	27	13	16	8	11	7	9	9	0	0	0	3.5	4.8
Sausage	21	12	14	5	6	7	21	11	2	1	0	5.1	6.5
Spareribs	47	16	9	8	7	3	8	2	0	0	0	1.8	3.4
Salt or side pork	64	16	5	2	1	4	6	2	0	0	0	1.5	4.1
Other pork	49	21	10	8	4	1	4	3	0	0	0	1.5	3.1

LAMB—MUTTON	**64**	**12**	**5**	**4**	**3**	**2**	**4**	**6**	**0**	**0**	**0**	**1.8**	**4.9**
Wholesale	99	1	0	0	0	0	0	0	0	0	0	.0	1.2
Chops and steaks	80	8	5	2	0	1	3	1	0	0	0	.7	3.6
Roast (leg etc.)	89	6	2	1	1	0	1	0	0	0	0	.2	2.2
Other lamb-mutton	81	10	3	2	1	0	2	1	0	0	0	.6	2.9
VEAL	**28**	**19**	**10**	**7**	**6**	**4**	**14**	**9**	**3**	**0**	**0**	**4.3**	**6.0**
Cutlets, chops, steaks	46	15	12	7	3	2	9	5	1	0	0	2.6	4.9
Ground veal	87	8	4	0	1	0	0	0	0	0	0	.2	1.7
Calf liver	93	4	2	1	0	0	0	0	0	0	0	.2	3.0
City chicken	88	7	1	1	0	0	3	0	0	0	0	.4	3.2
Roast													
(bone out)	81	11	4	2	2	0	0	0	0	0	0	.4	1.9
(bone in)	83	10	2	1	1	1	2	0	0	0	0	.4	2.4
Stewing, soup veal	94	5	1	0	0	0	0	0	0	0	0	.1	1.3
Other veal	85	11	2	1	1	1	0	0	0	0	0	.2	1.5
OTHER MEAT AND MEAT MIXTURES	**3**	**1**	**0**	**0**	**1**	**0**	**5**	**12**	**16**	**24**	**38**	**32.6**	**33.5**
Weiners and franks	7	4	4	3	4	5	17	27	19	6	4	14.6	15.7
Bologna—Ring or large round	12	6	6	5	5	5	20	21	14	4	2	11.4	13.0
Other cold cuts	9	5	7	5	3	3	17	22	17	7	5	14.1	15.4
Prem, Spam, Treat	50	18	8	7	3	2	6	6	0	0	0	2.5	5.0
Rabbit, domestic	90	7	2	1	0	0	0	0	0	0	0	.2	1.5
Venison and other game animals	87	8	5	0	0	0	0	0	0	0	0	.2	1.6
Chop suey meat and kabobs	75	10	6	4	3	1	1	0	0	0	0	.6	2.4
Bouillon cubes	75	18	4	1	1	0	1	0	0	0	0	.4	1.6
Beef stew	73	15	5	2	1	4	0	0	0	0	0	.7	2.4
Chili con carne	78	9	4	1	1	1	4	2	0	0	0	1.0	4.4
Hash	68	12	6	4	2	3	4	1	0	0	0	1.0	3.3
Mincemeat	70	22	5	2	1	0	0	0	0	0	0	.4	1.4
Meat balls and spaghetti	79	12	3	3	1	1	0	1	0	0	0	.5	2.6
Ravioli and tamales	83	7	4	2	1	1	2	0	0	0	0	.4	2.8
Chop suey, chow mein with meat	75	17	3	2	1	0	2	0	0	0	0	.5	2.1

TABLE 1—Concluded

Product	Percent of families buying, number of weeks											Average number of weeks purchases were made per family	Average number of weeks purchases were made per family buying
	None	1	2	3	4	5	6-10	11-20	21-30	31-40	41-52		
OTHER MEAT AND MEAT MIXTURES—(Cont'd)													
Potted meat	80	12	4	2	0	1	0	1	0	0	0	.4	2.1
Meat spreads	69	16	4	2	3	1	3	2	0	0	0	.8	2.8
Mixtures	84	12	3	0	1	0	0	0	0	0	0	.2	1.5
POULTRY	**1**	**0**	**0**	**1**	**3**	**1**	**10**	**42**	**25**	**13**	**4**	**19.9**	**20.1**
Broiling or frying chicken	5	6	4	8	4	6	32	28	5	2	0	9.2	9.7
Roasting chicken	65	21	7	5	1	0	1	0	0	0	0	.8	2.4
Stewing chicken	45	20	9	8	6	3	8	1	0	0	0	1.8	3.2
Barbequed chicken	92	6	1	1	0	0	0	0	0	0	0	.1	1.5
Turkey	36	39	17	6	1	0	0	1	0	0	0	1.1	1.7
Duck	92	7	1	0	0	0	0	0	0	0	0	.1	1.4
Game birds	93	7	0	0	0	0	0	0	0	0	0	.1	1.0
MIXTURES—Chiefly CHICKEN													
Chicken noodle dinner	97	2	0	0	0	0	1	0	0	0	0	.1	2.8
Chicken à la king	98	2	0	0	0	0	0	0	0	0	0	.0	1.5
Chicken chop suey	96	4	0	0	0	0	0	0	0	0	0	.1	1.2
Other (kind)	93	6	1	0	0	0	0	0	0	0	0	.1	1.6
FISH AND SEA FOOD	**4**	**1**	**1**	**3**	**4**	**1**	**16**	**38**	**24**	**6**	**2**	**16.0**	**16.6**
Tuna	18	9	8	9	8	6	20	17	4	1	0	6.6	8.1
Salmon	31	14	14	8	10	5	12	5	1	0	0	3.1	4.5
Fish sticks	61	17	6	4	2	1	6	3	0	0	0	1.4	3.7
Other fish	21	13	14	9	12	6	17	7	1	0	0	4.1	5.2

Lobster, L-tails	92	5	0	2	0	0	1	0	0	0	0	.2	2.1
Oysters	71	12	8	2	3	1	3	0	0	0	0	.8	2.6
Oyster stew	87	10	1	0	1	0	1	0	0	0	0	.3	2.2
Scallops	91	5	2	2	0	0	0	0	0	0	0	.4	4.2
Shrimp	58	12	6	7	5	3	7	2	0	0	0	1.6	3.9
Tuna pie or casserole	89	8	3	0	0	0	0	0	0	0	0	.2	1.5
Sardines in oil	77	10	4	3	3	1	2	0	0	0	0	.6	2.7
Sardines in sauce	85	11	2	2	0	0	0	0	0	0	0	.3	1.8
SOUP, BROTH, CONSOMME													
Vegetable and meat soup	25	12	10	9	7	3	17	10	6	1	0	5.7	7.6
Chicken soup or broth	25	9	8	8	9	3	16	15	4	2	1	6.3	8.6
MEAT PIES													
Beef pie	70	9	9	3	3	1	2	2	1	0	0	1.1	3.9
Chicken pie	55	16	9	4	5	4	4	3	0	0	0	1.5	3.3
Turkey pie	70	11	5	5	3	0	4	2	0	0	0	1.1	3.7
Pizza pie mix	81	10	4	1	1	2	0	1	0	0	0	.6	2.8
Pizza pie prepared or frozen	84	9	3	2	1	1	0	0	0	0	0	.3	2.1

CONSUMER EVALUATION OF FOOD MARKETING INFORMATION[1]

By MARCIA M. GILLESPIE and JAMES D. SHAFFER

Department of Agricultural Economics

DO YOU, A CONSUMER, want food buying information? Do you like the information about food buying now being published? Are there ways in which you feel it could be improved?

These were some of the questions which a group of 105 Lansing, Michigan, homemakers were asked in a study evaluating some of the releases prepared by Michigan's Marketing Information Program for Consumers. A panel of 14 home economists and marketing specialists also took part in the evaluation.

The food marketing releases selected were those prepared for the individual household, for use in newspapers, or for food-store distribution. The Marketing Program, under the Michigan Cooperative Extension Service, also prepares food marketing releases for the large-scale food buyer, in restaurants, hospitals, and other food services. These releases were evaluated in a separate study.[2]

The present study was intended primarily to benefit Michigan's Marketing Information Program for Consumers (MIC Program). It is hoped, however, that those working in similar programs in other states, as well as educators in broader consumer fields, will find some of the results of this study both interesting and helpful. It might be of general interest, for example, to note that the findings here indicated that consumers want food buying information stated simply in a concise, readable form. They like some food prices included in marketing information and they want to know how alternate foods compare in price and value. Where price advantages exist, consumers

[1]This report is based on an M.S. thesis by Marcia M. Gillespie (1958). An evaluation of selected releases of marketing information for consumers prepared by the Michigan Cooperative Extension Service, Dept. of Agr. Econ., Mich. State Univ.

[2]M. D. Boyts (1957). An evaluation of marketing information for restaurants, hospitals, and schools. Unpublished M.S. thesis, Dept. of Agr. Econ., Mich. State Univ.

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want to have these facts made clear. Further results indicated that consumers do not understand some terms used commonly in food marketing releases.

METHOD

Each of the 10 MIC agents working in Michigan was asked to submit four typical examples of each type of release prepared in 1956-57. A total of 105 releases were submitted. Since the agents selected the releases themselves, it is expected that the releases represented what the agents believed to be the best examples of their work.

The content of the total sample of releases was first analyzed and evaluated by the author. Here, a critical approach was used in order to make constructive recommendations for the program's improvement. From this sample, two releases were selected for the evaluation by the panel of consumers and the panel of specialists. The two releases were chosen to illustrate differences in style, organization, content, and length, as a means of comparison. Price quotations were included in only one of the releases. The results of both panels' evaluations were compared with the author's evaluation of the same material as a means of testing the validity of the author's appraisal.

A random sample of Lansing, Michigan, households was drawn to obtain a sample of a minimum of 100. An initial contact was made with each consumer and at that time the sample releases and the questionnaire based on the releases and the excerpts were left with each participant. After several days the questionnaire was picked up. Because of the work involved in reading and rating the releases, less than half of the homemakers who were contacted, completed the questionnaire. As a result of this, the consumer sample had proportionately fewer participants in the low income and low education groups than the general population.[3]

THE EVALUATION RESULTS

Consumers Want Food Marketing Information

The homemakers on the panel were asked if they would look for and read MIC releases regularly in the newspaper or food store. Sample releases were included with the questionnaire.) The majority of the homemakers answered "yes," but some qualified their answers

[3]A supplementary study has been initiated to study the food information needs and wants of the lower income consumer group.

with such remarks as: "If the releases are readily available and in the same spot (in the newspaper or store) each week."

A majority (63 percent) of the Lansing homemakers said they had in the past read MIC releases in the local newspaper at least once a month on the average (another indication of consumer interest in this type of information). Similar results were obtained in R. E. Borton's study.[4] Further evidence of interest in this type of information was given by the response of the professional group. All of the specialists working in the area of foods from the consumer's standpoint (i.e., food preparation, management, or marketing) when asked if they would like to be supplied with MIC releases for use in their work, indicated that they would.

What Consumers Want In Price Information

The two MIC releases evaluated by both panels were selected by the author to show specific differences. The specialists indicated by their numerical scores and comments regarding each release, that price quotations, included in only one of the releases, increased the potential value of food buying information for consumers. Similarly, many of the homemakers indicated that price quotations and price comparisons, in particular those presented simply and specifically, were useful to them as buying information.

Three excerpts of comparative price information were also evaluated by the respondents. The homemakers, in general, gave top rating to an excerpt from a food marketing release in which a price comparison was made in a simple, direct statement, without a price quotation. The excerpt follows:

> Right now pork sausage will cost you less than bacon for those better breakfast menus we're always talking about.

The majority of both the specialist group and the homemaker group rated this "useful information."

Another excerpt drew attention to price differences attributed to the size, quality, or service characteristics in a food. The reaction of many of the consumers to this information, however, was that the price advantage was not made entirely clear in this case. The excerpt follows:

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[4]Borton, R. E. (1957). Consumer use of mass media for food information. Unpublished M.S. thesis, Dept. of Agr. Econ., Mich. State Univ.

> Broiler-fryer prices will interest most homemakers. There is about a 20 cent per pound difference in fryers, depending upon size, quality, and whether they are cut up or whole.

Less than half of the homemakers (47 percent) rated this "useful information" and only about one-third of the specialists gave this rating to the excerpt.

The two groups of respondents differed markedly in their evaluation of the following excerpt of price and value information:

> Plump, breaded-and-cooked chicken thighs cost about $1.00 for a package of four. Serve two thighs per person and spend about 50 cents. Look expensive? If you buy a fresh fryer for 43 cents a pound and allow ¾ pound of chicken per person, you spend about 35 cents for a serving of fried chicken.

All of the specialists rated this "useful information." However, just less than half of the homemakers (48 percent) gave a top rating to the information and almost a quarter of them rated it "not useful" as buying information. Some homemakers remarked that such information was confusing. Another remarked that (as was often the case in such information), the serving portions were too meager to be practical for her family and, as a result, the costs per serving had little meaning for her. The specialists were agreed that such information was useful, but some suggested that only one such detailed item should be included in each release. Otherwise the reader would be confused.

"Good" meat buys were listed in two excerpts, one containing price quotations. A majority of the homemakers who responded rated **both** excerpts "useful information" for them. Proportionately fewer specialists rated these excerpts as "useful information." Some pertinent comments were made by the homemakers in their evaluation of these lists of "good food" buys. Some felt that the price quotations given in the one excerpt, without serving portions or costs per serving, did not make value comparisons possible, and the information was less useful as a result. Other respondents remarked that the wide price ranges, which were given in one without explanation, were meaningless. Some homemakers suggested that such terms as "reasonable" and "moderate price range," which were used in these excerpts, needed a basis for comparison to mean anything to them.

What Consumers Want in Outlook Information

Two types of outlook information were evaluated by the respondents. One excerpt was an example of short-range outlook (i.e., what to expect in supply, price, or quality within the week). This type of outlook occurs frequently in MIC releases. The second excerpt illustrated long-range outlook (i.e., a forecast of the supply, price, or quality situation for the year). This type of outlook is presented generally only at the beginning or end of a year, in the MIC Program.

A high proportion of both groups of respondents rated the short-term outlook "useful information." Less than a third of the homemakers gave this top rating to the long-range outlook however. The majority of the specialists rated the long-range outlook as information "not useful" to consumers. The author feels that the value of long-range outlook cannot be minimized on the basis of these results. Perhaps as consumers learn the value of planning over longer spans of time, such information will become increasingly valuable. Some exposure to this type of information for this reason is felt to be necessary even though presented only once or twice a year, as in the MIC Program.

In one release a calendar of harvest dates for different varieties of peaches was given in a tabular form. Many favorable comments were made by the homemakers regarding this type of outlook information. The comments referred both to the information itself and to the concise form in which it was presented.

How Consumers Rated Excerpts of General Food Marketing Information

The respondents evaluated the usefulness to consumers of the following excerpt:

> If you're looking for something in the moderate price range, pork shoulder is an excellent choice. When roasted with your favorite stuffing and served with fresh applesauce, pork shoulder becomes the mainstay of a substantial autumn meal.

A high proportion of the homemakers gave this excerpt the top rating as did a majority of the specialists. Many respondents commented that menu ideas which included "economy meats" are eagerly sought.

A preparation suggestion for a low-cost cut of meat was evaluated by the panels. Forty-two homemakers rated the excerpts "useful,"

and another 42 rated it "perhaps useful." One of the more common reasons for rating this excerpt lower was that the suggestion involved a long food preparation and required equipment (for grinding raw meat) which they did not own. These features would discourage them from attempting the preparation, some said.

In another excerpt the current market situation was outlined as follows:

> Marketings of lettuce, local fall crop potatoes, and apples are expected to remain at a high level.

Less than half of the homemakers rated this "useful information." A majority of the specialists rated the excerpt "not useful" as information for consumers. The most frequent suggestion made for improving the excerpt was to define or make clear the meaning of the expression "marketings . . . at a high level." (Some of the comments indicated that respondents in both groups associated either high price or high quality, rather than abundant supply, with this expression.) Many homemakers commented that the information in the excerpt lacked significance, that is, "it would be read and forgotten." Some said too that they regarded these particular items as "staples" which were bought regardless of their price.

The homemakers and specialists differed in their rating of the brief excerpt which follows:

> When buying turkey check the labels. The more mature birds require longer cooking.

Well over half of the homemakers group rated this information "useful," whereas only one-third of the specialists answering rated it "useful." The idea was new to many homemakers that maturity of some fowl is indicated on the label. However, many of the respondents were in doubt as to just what information would be found on the label to indicate maturity—age? weight? sex?

How Consumers Rated Excerpts of Nutrition Information

It should be pointed out before discussing the results here that nutrition education is not a primary aspect of the MIC Program. Nutrition is included as marketing information as one of the factors for consideration in choice making, particularly among foods which are close alternates.

Four nutrition excerpts from MIC releases were each rated "useful information" by the majority of homemakers. These results oppose,

to some extent, those in M. B. Minden's study[5] in which it was reported that consumer interest in nutrition is not high compared with such other subject areas as time management, food buying, food selection, and economizing.

One of the nutrition excerpts described the food value in a quart of milk in such terms as: "provides 144 percent of a woman's daily calcium requirement, 120 percent of the needed riboflavin, 62 percent of the protein requirement and 31 percent of the daily quota of vitamin A." Over half of the homemakers rated this rather detailed and technical excerpt as "useful information." Some homemakers however, commented that for them the information needed to be simplified, or that it needed to be given in terms of the daily recommended allowance of milk for a woman to be meaningful. The majority of the specialists rated this information as "perhaps useful" from the aspect of its value to consumers.

One professional drew attention to several misconceptions in the nutrition excerpts which resulted from either too general a statement regarding the nutritive value of a food or to outdated standards. In such aspects, the "average consumer" is not generally qualified to judge. The more critical judgment of the specialist group as a whole can be attributed to their technical training.

RECOMMENDATIONS

The recommendations made to the Michigan MIC Program were a blend of the author's evaluation of the sample of one hundred and five MIC releases and of the evaluations by the two consumer groups. In making these recommendations, the author recognizes that each agent is restricted in what she can do by local circumstances. There are the limitations of the particular medium, the requirements of food editors, the programming atmosphere, and other limitations. For these reasons not all of the recommendations will be applicable for a particular program. In some cases, undoubtedly, the recommendations will be applicable only after some modification or adaptation to meet the specific requirement of the local situation.

The recommendations follow:

1. Reduce the amount of narrative in MIC releases and condense the information. Some of the methods suggested for doing this included:

[5]Minden, M. B. (1957). The consumption decision and implications for consumer education programs. Unpublished Ph.D. thesis, Purdue Univ., Ind.

a. Tabulate prices, cost comparisons, and other statistics.
b. List, for quick reference, the foods with price, quality, or supply advantage.
c. Present information graphically, in diagram, chart, or in picture.
d. Make more use of the question-answer technique, where appropriate.
e. Present highlights in lead sentences of each paragraph.

2. Use a distinctive title head for all MIC releases for identification purposes.

3. Include more time-saving suggestions for planning, buying, and preparing foods.

4. Simplify adjustments in the food budget by including more of the following kinds of information:

a. Show how foods can be substituted in planning an adequate diet. Discuss comparable market baskets, comparable menus, for example.
b. Suggest methods of preparing the less expensive, nourishing foods.
c. Include frequent price-value comparisons, such as, fresh vs. processed; grade A vs. grade B; pork vs. beef; service vs. non-service; large quantity vs. small; current vs. seasonal price.

5. Include frequent suggestions for food combinations and brief preparation suggestions, for the lower cost cuts of meat in particular.

6. Define terms commonly used in presenting buying information, such as Boston Butt, capons, caponettes, broiler-fryers, pork loin, pot roast, side pork, variety meats, and reasonable price.

7. Discuss grades and standards, food laws, and regulations, for their implications to consumers.

8. Give more emphasis to a discussion of price-making forces, that is, the costs of marketing food, influence of supply-demand factors, and general economic conditions.

9. Present nutrition information which will aid in the selection of an adequate diet at different economic levels with reference to current food prices. Tentative results of this study indicated that nutrition information presented in the framework of common dietary problems such as overweight, appeals to consumers.

10. Build the information in the "feature-type" releases around one or two key points.

11. Plan a series of feature articles based on common food problems and consumer interests such as:

a. Meal planning on a low or moderate income.
b. Why and how to save money in food shopping.
c. Changes in the food industry.
d. Food laws that make eating safe.
e. Consumers look at the costs of marketing foods.
f. Questions asked by the "young marrieds" about food buying.

The following four recommendations refer specifically to the market situation releases (a type of release giving an overview of the price, supply, and quality situation in the current food market).

12. Separate the information by food groups and distinguish each group by headings.

13. Identify clearly the foods having price, quality, or supply advantage, possibly by:

a. Listing under "Meats To Look For," "Fresh Fruits to Look For," etc.
b. Giving a weekly menu suggestion developed around the food "buys."
c. Printing the food "buys" in bold type or italics.

14. Feature one lower cost meat weekly and include such information as:

a. Buying guides
b. Preparation suggestions
c. Menu suggestions

15. Include more marketing information on dairy products, cereal products, fats, and oils, and proportionately less on fruits and vegetables.

16. In a number of cases the evaluations of the consumers and the specialists were quite different. This indicates the need for a rather broad representation on local and state advisory councils for the MIC Program. It is important to have a continuous contact with the kind of people who are the intended audience. At the same time, material should also be checked for technical accuracy by specialists in food marketing, nutrition, and related fields.

17. Further effort should be made to reach lower income families who also are typically less well educated. Special research is needed to determine the needs and approaches which are likely to be successful in getting information to this group who, in one specialist's

opinion, "are not being reached by the MIC Program and who need help so desperately with their food buying."

This evaluation study was but one phase of the continuous process of evaluation carried out by the administrators of the Michigan MIC Program in the search for more effective methods of presenting marketing information to consumers.

CONSUMERS DO SHOP AROUND FOR MEAT[1]

By JAMES D. SHAFFER

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WHAT PERCENT OF THE FAMILIES buy most of their meat from the same source for 2 consecutive weeks? How many families buy meat from two different sources during a week? How much variation is there in the percentage of families buying meat from particular sources from week to week? The purpose of this report is to give some indication of the answers to these and other questions related to consumer shopping patterns for meats.

This report is based upon data obtained through the Michigan State University Consumer Panel. The panel consists of a sample of families selected to be representative of a Michigan city of about 100,000 population.[2] Each week, panel families report in an itemized diary the quantity, price, and expenditure for each food item purchased for home consumption during the week. This report deals with meat purchases during 1956. Approximately 270 families reported during an average week in 1956. For some purposes only the data for the 225 families reporting 50 or more weeks were used.

Description of the Sources of Meat Purchased

In 1956 the panel members were asked to report the sources of their meat purchases. The possible responses were limited to 9 alternative sources of purchases, which were:

Wrigleys (Big Bear)
National Market Basket
Kroger
A & P

[1]M.S.U. Consumer Panel Report No. *48*. The M.S.U. Consumer Panel is operated under the direction of G. G. Quackenbush.

[2]See Shaffer, J. D. (1954). A plan for sampling a changing population over time, Jour. Farm Econ. 30:153-163; and Shaffer, J. D., and G. G. Quackenbush (1955). Cooperation and sampling in 4 years of the M.S.U. Consumer Panel operation, Mich. State Agr. Expt. Sta. Quart. Bul. 38:85-103.

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Schmidts
Shop-Rite
Bazley or Junedale
Any other grocery store or meat market not listed above (which we will from here on call the independents).
Any place other than grocery store or meat market, i.e. delicatessen, farm, city market, food locker plant, etc.

A code was listed for each of these groups of stores and the homemaker simply listed the letter code following each purchase reported.

Panel families reported expenditures of about $50,000 for the meat items included in this report during the year. They failed to indicate the source of purchase for less than 1 percent of this expenditure. They indicated the source for a total of 51,053 purchases, amounting to about 94,987 pounds of meat costing about $49,503.

The seven organizations listed by name as sources of meat, had a total of 26 stores in the shopping area in 1956. The number of stores per organization ranged from one to seven. Panel families reported buying about 62 percent of their meat from these seven "named" sources, 32 percent from other grocery stores (independents and meat markets) and 6 percent from other sources. Table 1 shows the percent of the total quantity, expenditures, and purchases made from each source.[3]

[3]Since the relative sales of individual organizations as such is not relevant to this study, data are not identified with the organization.

TABLE 1—Distribution of meat purchases by M.S.U. Consumer Panel families among alternative sources, 1956

Source(*a*)	Percent of total quantity	Percent of total expenditure	Percent of total number of purchases
A	13.9	14.2	14.8
B	12.3	13.5	15.6
C	10.2	11.6	11.2
D	8.2	6.7	7.5
E	7.3	6.7	7.4
F	6.5	6.7	6.7
G	3.6	3.7	3.7
"Independents"	31.9	31.6	30.4
Other sources	6.2	5.3	2.7

(*a*) The seven named sources are listed in order of percent of total quantity, which is not the same order as the listing of stores above.

Four of the named sources were national or regional chain organizations with a total of 14 stores. These stores accounted for about 30 percent of the total expenditures for meat. The three remaining named sources consisted of two downtown meat markets, a local grocery chain (three stores) and a local group of independent supermarkets who do cooperative advertising and buying (seven stores). Expenditures by panel families at these stores amounted to 32 percent of their total expenditures for meat. It was estimated that the independents category (all other grocery stores) included about 192 stores. This category accounted for 32 percent of the total expenditures for meat.

An indication of the volume of business done per store of these three groups is given by dividing the percent of total expenditures by the number of stores. Thus the average store of the national chains accounted for about 2.2 percent of total meat expenditures compared with 2.7 percent for the average store of the local named sources and about .2 percent for the average store of the independents category. The range in percent of total expenditures per average store was from 1.7 to 3.7 for the four national or regional chain organizations and from 1.7 to 4.7 for the local named sources. No information was available which would indicate the number of outlets which were included in the category "other sources."

Definition of a Purchase

This report deals primarily with the red meat purchases which would usually be made in the meat department of a super market. It does not include such canned products as meat balls and spaghetti but does include canned pork and canned beef. Poultry, fish, and other sea foods are not included.

A purchase is somewhat arbitrarily defined as the buying of some of a class of meat products during the reporting week from a particular source. Because of the necessity of grouping items it was possible to "report" only 19 different purchases of fresh beef from a particuar source in a week. If hamburger were bought twice from the same source during a week, it would be recorded as a single purchase.

A further indication of the detail of specification may be illustrated by the manner in which beef steak was classified. Round steak and sirloin were each a separate category while porterhouse and T-bone steaks were combined. All other steak was combined into a single group.

If the meat were frozen, it was treated as a separate purchase from its fresh counterpart. Pork was also classified in 19 categories while lamb and mutton included five and veal nine. An additional five groups were canned beef, canned pork, wieners and franks, bologna, and other cold cuts.

From how many sources did families buy? Some idea of the extent of store loyalty or extent of "shopping around" for meat is indicated by the number of different sources families bought from during the year. Table 2 shows the percent of families buying from different numbers of sources. It shows, for example, that 4 percent of the families bought all of their meat for the year from a single source. However, the majority of families (58 percent) purchased meat from five or more of the nine sources during the year and 1 percent purchased from all sources.

Another indication of the extent of shopping for meat is the number of weeks the families bought from more than one source. About 60 percent of the weekly observations[4] were for purchases from one source, 33 percent from two sources, 6 percent from three sources, and 1 percent from four sources. Eighteen observations were made of families actually buying meat from five different sources during the week.

Table 3 shows the distribution of families according to the number of weeks out of the year they purchased meat from two or more

[4]Weekly observation refers to the purchases of one family during a single week.

TABLE 2—Percentage of panel families purchasing meat from different numbers of sources in 1956

Number of different sources	Percent of families
1	4
2	8
3	9
4	20
5	20
6	17
7	14
8	7
9	1
	100

TABLE 3—Distribution of panel families according to the number of weeks out of the year they purchased meat from two or more sources

Number of weeks	Percent of families
0	4
1-4	13
5-9	13
10-14	17
15-19	10
20-24	11
25-29	12
30-34	7
35-39	6
40-44	3
45-52	4
	100

sources. Almost one-third of the families purchased meat from two or more sources half of the weeks of the year.

How many bought from each source? Table 4 shows the percent of panel families buying from each of the nine sources during the year. Over 90 percent of the families purchased some meat during the year from the "independents." Over half made purchases from sources other than a grocery store or meat market. At least 40 percent of the families purchased meat from each source.

TABLE 4—Percent of panel families purchasing meat from each source in 1956

Source(*a*)	Percent of families buying
T	40
U	40
V	42
W	52
X	52
Y	57
Z	64
"Independents"	92
Other sources	55

(*a*) The seven "named" sources are simply listed in order of their rank in terms of percent of families buying.

Week to Week Variation

How many families made their largest expenditure for meat at the same source from one week to the next? To determine the extent of week to week shift in source, five 2-week periods were examined.[5] An average of 64 percent of the families made their largest expenditure for meat at the same source in successive weeks. That is, an average of over one-third of the families switched their largest expenditure for meat from one week to the next. The percent of families switching ranged from 32 to 39 percent for the five periods studied.

This does not mean that a third of the families change their store preference from week to week however. Over one-third of those included as switching source of larger expenditure from one week to the next purchased some meat the second week from the source of largest expenditure of the previous week.

Another indication of the continuity of purchase pattern from week to week was the finding that, for the five 2-week periods, an average of 86 percent of the families reported purchases from at least one of the same sources in both weeks. In other words, only 14 percent bought all of their meat from completely different sources the second week than from the previous one.

However, about half of the families reported purchase of some meat the second week from a source they had not purchased meat from the week before.

An inspection of the data showing the percent of families buying from each source each week and the percent of total expenditures for meat made at each source each week indicates a very considerable week to week variation in the shopping pattern for meat. These data are summarized in Table 5 which shows the average and the range in the weekly percent of families buying and percent of total meat expenditures for each source.

The greatest range, as would be expected, was in the percent of the total expenditure going to "other sources" which varied from less than 1 percent to 19 percent. This category includes purchases from locker plants and other sources supplying wholesale cuts. It would be subject to wide variation as a result of very large purchases by a few families and is not likely representative of the total population. However, the fact that the percent of families buying is also highly

[5]The periods selected were weeks 10-11, 20-21, 30-31, 40-41, and 50-51 in order to give seasonal representation.

TABLE 5—Range in percent of families buying from each source each week and the percent of total meat expenditures made at each source each week. M.S.U. consumer panel, 1956

Source(a)	Percent of families buying		Percent of families expenditures	
	Average	Range	Average	Range
1	5	2-9	4	2-6
2	8	5-12	7	3-10
3	11	7-15	7	4-10
4	11	7-15	7	4-11
5	13	10-16	11	8-19
6	17	13-20	14	10-22
7	21	17-26	13	10-17
"Independents"	39	35-47	32	23-38
Other sources	5	2-9	5	1-19

(a) Listed in order of average percent of families buying.

variable indicates there is more to this variation than large chance purchases.

The percent of total expenditures gained the high week was more than twice that of the low week for all but two sources. One of these latter was the "independents" category which varied from 23 to 38 percent. Over half the sources received the meat patronage of twice as large a percentage of the panel families some weeks as others.

TABLE 6—Variation in characteristics of meat purchases among sources

Source(a)	Average quantity per purchase	Average expenditure per purchase	Average number of purchase per stop	Average quantity per stop	Average expenditure per stop
	lb.			lb.	
1	1.8	$ .87	2.5	4.5	$2.16
2	2.0	.86	3.3	6.7	2.86
3	1.8	.97	2.2	4.0	2.16
4	1.5	.84	2.6	3.9	2.21
5	1.8	.94	3.2	5.6	3.00
6	1.7	1.00	3.2	5.4	3.20
7	1.8	.97	2.6	4.8	2.54
"Independents"	2.0	1.01	2.8	5.5	2.83
Other sources	4.4	1.92	2.0	8.5	3.75
Total	1.9	.97	2.8	5.2	2.70

(a) Listed in random order.

Variation of Size of Purchase

One of the possibilities raised by the findings that many families buy meat at two or more stores in a week is that major purchases are made from the larger stores and the smaller neighborhood or "independent" stores are used for minor purchases to fill out the week's needs. There may be some truth to this, but there is little evidence of it in the data. Table 6 summarizes some data relevant to this question.

The first and second columns of Table 6 show the average quantity of meat bought per purchase and the average expenditure per purchase. It indicates that purchases made from the independents were larger than the average of all purchases and averaged larger than those for all but one of the "named" sources in terms of both quantity and expenditure.

There is, of course, the possibility that this result is due to the aggregation involved in defining a purchase. If, for example, hamburger was purchased three times from independent stores (either one or three) it would be counted simply as one purchase. However, it does not appear likely that the same meat item would very frequently be purchased from more than one independent store during a week and, therefore, it is not believed this is an important factor affecting these results. These families would be just about as likely to buy the same item at two different times from one of the groups of stores "named" as they would to buy the same item from two different independents.

It should also be noted that while the average store of the "named" sources accounted for over 10 times the average expenditure per independent store, there are a number of fairly large stores included among the independents.

The last three columns of the table show the average number of purchases, average quantity, and the average expenditure per stop. A stop in this case refers to the purchases made during a single week by a family from a single source.

Here again, the problem of the aggregative nature of the data provides some difficulty. For example, it would indicate purchases from two independent stores or two stores of a particular chain as a single stop. The reader will have to judge for himself the frequency with which this is likely to occur.

An average of less than three meat purchases per stop were made

by panel families. The average for the independents was the same as the average for all sources.

The average quantity purchased per stop was about 5 pounds with the average for the independents slightly larger than average. The range was from 3.9 to 6.7 pounds if the "other sources" category is not included.

Purchases from "other sources" (locker plants, farmers' markets, delicatessen etc.) averaged about twice as large as the average of all purchases and the average quantity purchased per stop was about 1½ times as large as the average of all sources.

Comparison with Survey Data

During the spring of 1956 a survey was made of the same area covered by the panel. A random sample of 2,103 households answered several questions dealing with meat purchases along with other questions.

One of the questions asked the homemakers was, how much they spent for meat the previous week from each of the nine sources discussed in this report. The percent of total expenditures reported spent for meat at each source was very similar for the panel and the survey. The four national or regional grocery chains accounted for 33 percent of the total expenditure in the survey compared with 30 percent reported by the panel.

The local chain, cooperative group, and two meat markets received 32 percent of expenditures by panel members and 27 percent according to the survey. The survey showed the "independents" got 33 percent of expenditures compared with the panel estimate of 32 percent. The share of the market going to other sources was 7 percent for the survey and 6 percent according to the panel.

The estimates are remarkably consistent considering that the survey covered only a few weeks compared with an entire year by the panel. Also the definition of meat was left pretty much up to the respondent in the survey and was strictly defined for the panel. These might have some influences on the distribution of expenditures between sources.

A much more substantial difference was found when comparisons were made for two additional factors. Of those families reporting meat purchases in the survey, about 80 percent reported buying from only one source, 17 percent from two, and 3 percent from three or more sources.

Another question asked was, "Did you buy most of your meat last week from the same store where you bought most of your meat the week before?" About 85 percent answered "yes." This, of course, is substantially different than the average of 64 percent of the panel members found to buy most of their meat from the same source in successive weeks. The survey finding is much closer to the panel estimate that about 86 percent of the families bought some meat from the same source in successive weeks.

There was considerable variation in the percent of families buying from two or more sources from week to week. When a count was made for a single week during the spring of 1956, only 70 percent reported purchases from a single source, 26 percent from two sources, and 4 percent from three or more sources.

There are at least two possible explanations for these differences. One is that there is a substantial memory bias in a recall survey. It is quite easy to imagine a number of homemakers forgetting the "other" places they or one of the family members bought meat during the previous week. Thus, it would not be surprising to find an underestimating bias in the number of families buying meat from more than one source.

A critical examination of the recall question, "Did you buy most of your meat last week from the same store where you bought most of your meat the week before?" also suggests the possibility of a substantial underestimate of the number who purchased most of their meat from different sources. There is probably a tendency for some homemakers to generalize thinking they usually buy meat from a certain source and, therefore, give this as an answer.

Respondents frequently have a tendency to report what they believe to be their usual behavior even when asked specifically what they did the previous 2 weeks. Not having records of their purchases for those 2 weeks they might interpret buying meat at the same source as buying most of their meat at the same source. It must also be admitted that the manner of asking the question itself would probably tend to bias the response in favor of a "yes" answer. If it had been asked in terms of purchasing at a *different* store in place of the *same* store the response would likely have shown more homemakers buying most of their meat at different stores. This discussion illustrates some of the problems involved in getting reliable information about consumption patterns through recall questionnaires.

Another possible explanation of the difference in estimates between the panel and survey is that the panel consists of families which are more likely to shop around than is true for the population in general. While considerable effort is made to keep the panel representative of the population, it is true that it includes only families willing to keep a weekly food diary. Controls are maintained to insure representativeness in terms of six important socio-economic characteristics but there is no way to control the propensity to shop around.

It may also be that keeping the record itself would encourage more competitive shopping. If there is a bias in the panel data it would be expected to be in the direction of overestimating the extent of shopping around for meat.

It would seem most likely that reporting errors would tend to result in underestimates of the propensity to shop around for meat from a recall survey while the conditioning effect and sampling biases in the panel would tend to result in moderate overestimates of this leaning. It would not appear, however, that the errors are great enough to substantially modify the general findings of this report.

SUMMARY

This study indicates that consumers typically shop for meat at a number of different sources.

Only 4 percent of the families reported buying all of their meat from a single source during 1956. Over half the families reported purchases from five or more of the nine sources during the year.

About one-third of the families reported buying meat from two or more sources during more than half the weeks of the year.

About one-third of the families made their largest expenditure for meat at a different source the second week of a 2-week period than the first week. About one-half the families reported purchases of some meat the second week from a source they had not purchased meat from the week before. At the same time, 86 percent of the families reported purchases from at least one of the same sources in two successive weeks.

The pattern of meat purchases among the various sources shows considerable week to week variation.

A comparison with survey data indicates that the panel data may be biased so as to overestimate the propensity to shop for meat.

The findings of this study indicate that most families do not have strong store loyalties for buying meat. Each week enough families buy from two sources or change the source of major purchase from the previous week that it would appear difficult or unprofitable for any one store or group of stores to maintain a meat merchandising policy which was not competitive with the other stores.

This study also indicates that no store or source is doing such an outstanding job of meat merchandising that it has gained complete loyalty of any substantial number of families.

CHANGES IN LAND USE THAT WOULD BE EFFECTED BY ADOPTION OF CONSERVATION FARM PLANS IN 53 MICHIGAN SOIL CONSERVATION DISTRICTS

By EARL E. FENTON[1]

INTRODUCTION

THE MICHIGAN SOIL CONSERVATION DISTRICTS LAW was enacted in July, 1937. This act, amended in 1945, provided a means for farmers and other landowners on petition, hearing, and referendum, to organize local units of government to protect their soil and water resources. As of January 1, 1958, 75 local soil conservation districts, covering more than 90 percent of the farm land of the state, had been organized.

The basic objective of the program of the districts is to promote good land use through the establishment of complete soil and water conservation programs on the lands of the district. The Soil Conservation Districts Law sets forth the powers of districts and of the district governing body. Among other powers they have authority to secure and furnish to landowners and operators such assistance from governmental agencies as can be utilized in furthering the district program.

Technical assistance in conservation farm planning is provided to the districts, at their request, by the Soil Conservation Service of the United States Department of Agriculture. Farmers avail themselves of these planning facilities by making an application to the district directors.

In working with an individual landowner in developing a soil and water conservation program for his lands, and in planning for estab-

[1]Earl E. Fenton is area conservationist, Soil Conservation Service, Jackson, Michigan. During period of preparation of this report he was temporary instructor (research), department of resource development, Michigan State University.

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lishing appropriate conservation practices, the technician and the farmer are guided by the following: (1) an inventory of the lands involved which indicates soil type, percent of slope, degree of erosion, and capability of the land, as well as other pertinent information on land conditions; (2) results of research indicating the effectiveness of various conservation programs and practices in controlling erosion, preventing soil deterioration, and in improving soil conditions; (3) type of farming enterprise in which the farmer is interested; and (4) financial and managerial ability and desires of the farmer to carry out various alternative conservation programs.

Considering these factors, the technician and the farmer work together to develop a plan for the farm. The farmer decides which type of land use program he intends to follow. His decision is recorded and becomes the basis for an agreement between him and the district.

PURPOSE OF THE STUDY

During the relatively short time that Michigan farm lands have been under cultivation, much erosion and soil deterioration has occurred. Planning for conservation programs that will effectively protect the soil and water resources of the state calls for changing conventional practices and patterns of land use and treatment that have caused or resulted in soil erosion and deterioration. Likewise, improvement practices e.g., tile and open ditch drainage, also included in conservation planning programs, frequently permit a land use that previously had not been possible.

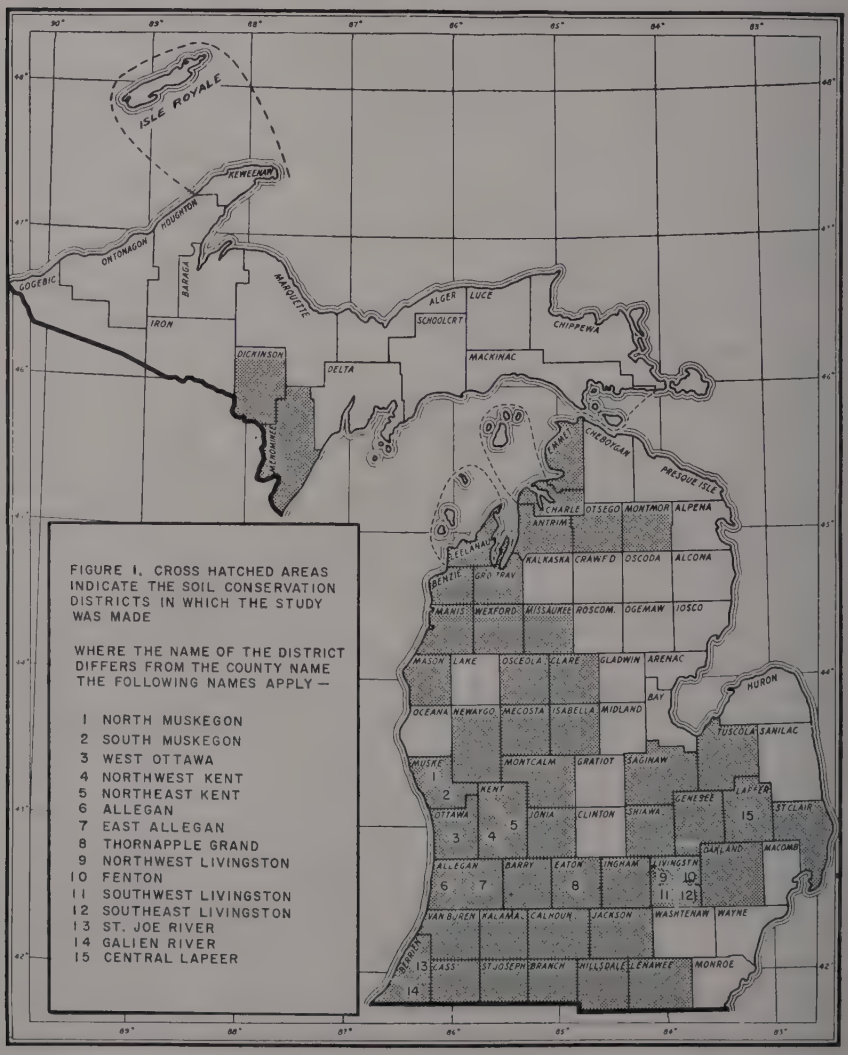
In 1952, Soil Conservation Service technicians were assisting farmers in 67 Michigan soil conservation districts plan soil and water conservation programs. At that time about one Michigan farmer in 16 had developed a conservation farming program in cooperation with his soil conservation district. With such a program in operation and available to a majority of Michigan farmers, it seemed timely to evaluate the changes in land use that would be effected by the acceptance and establishment of conservation programs on a much larger percentage of Michigan farm lands. This study was begun early in 1952.

METHOD OF STUDY

The source of data for the study was a selected sample of conservation farm plans. The samples were chosen from each soil conserva-

tion district where enough plans had been developed for a sample to adequately reflect the local trends in conservation planning.

The study was directed only at an evaluation of land use changes that would be effected by conservation planning. It was not, therefore, designed to include information on planned acreage changes for individual crops, changes in soil management practices that were provided in the conservation plans, nor information on changes in yields.



No attempt was made to determine the actual extent to which the planned programs of the sample plans had been applied on the land.[2]

Fig. 1 indicates the 53 soil conservation districts that were included in this study. The 53 districts cover 16,889,370 acres. An effort was made to secure a sample of plans scattered throughout each local problem area[3] in sufficient numbers to represent an acreage equivalent to 3 percent of each area.[4]

From the simple plans, data were tabulated on the land use pattern existing at the time the conservation farming program was developed, and on the land use pattern that would be achieved through the carrying out of the planned conservation program.

OBTAINING THE DATA

Specific data were obtained for the two periods on each of the following eight land use categories:

1. **Row crops** — a crop planted in rows, usually 2 to 4 feet apart, to allow cultivation between the rows during the growing season. This includes all intertilled crops except those described as truck garden crops. In Michigan, the most common are corn, field beans, soybeans, sugar beets, and potatoes.

2. **Small grains** — grains which are either sown, broadcast, or drilled in close rows so that they cannot be intertilled. In Michigan, the most common are wheat, oats, rye, barley, and buckwheat.

3. **Rotation hay and pasture** — hay land and/or pasture land which is a part of a regular planned crop sequence or rotation, as contrasted to a permanent pasture or meadow. It may include annual, biennial, or perennial legumes and grasses. The most common ones in Michigan are alfalfa, red clover, ladino clover, alsike clover, sweet clover, timothy, and bromegrass.

4. **Permanent pasture** — land occupied by grasses and/or legumes which remain in pasture indefinitely. Included here are unimproved pastures and those areas which have been seeded to grass and/or

[2]A study of this type has been reported on by C. R. Hoglund (1955). Soil conservation in Michigan, progress and problems. Mich. Agr. Expt. Sta. Spec. Bul. 394. 66 pp.

[3]Problem area refers to a land unit within a soil conservation district where the associated soil, drainage, slope, erosion, and soil conservation problems are essentially the same.

[4]The procedures utilized in the collection of basic data were developed by John S. McVickar, head, department of agriculture, Western Illinois State College, Macomb, Illinois; formerly research assistant, department of resource development, Michigan State University. For a more detailed description of the sampling procedure see John S. McVickar (1954). The problem area as a basis for developing a soil erosion map. Jour. of Soil and Water Cons., 9 (6). Mr. McVickar was assisted in the collection and tabulation of data by Mr. Lewis E. Arnold, formerly research assistant, department of resource development, Michigan State University.

legume species with the intention that the continuing use of the land will be for pasture. Land, in this category, may have stumps and some trees — up to 40 percent of the area may be shaded.

5. **Woodland** — land used for the production of forest trees. This includes land which, prior to planning, was at least 40 percent shaded, was reforested, or after planning will be devoted to the production of forest trees.

6. **Orchard** — land devoted to the production of fruit which grows on either a tree or a bush. Such fruits as apples, cherries, peaches, raspberries, blueberries, and blackberries are included.

7. **Truck gardening** — land devoted to special crops such as vegetables, mint, or strawberries.

8. **Miscellaneous and idle** — this category includes all farmsteads, roads, lanes, fences, idle or unclassified lands, wildlife areas, and any other land not used to produce regular income for the farm.[5]

The data from the farm plans in each problem area were tabulated according to the above eight land use categories. From these data, estimates were made of the problem area land use pattern existing prior to any conservation planning and what the land use pattern would be following complete conservation planning. Data were tabulated and estimates made in this manner for about 450 individual district problem areas.

METHODS OF ANALYSIS

For analysis purposes, data from the 450 problem areas were consolidated as follows: (1) on the basis of a modified version of the type of farming area map developed by Elton B. Hill and Russell G. Mawby of the department of agricultural economics, Michigan State University[6] and (2) on the basis of the major Michigan soil associations as developed by I. F. Schneider and E. P. Whiteside of the Michigan State University soil science department.[7]

[5]For the purposes of this study, there was no designated wildlife pre-planning data available for comparison with the data on land use planned for wildlife in the conservation plan. This is because, before planning, farmers generally did not recognize a use of land specifically designated for wildlife. Thus, in this type of study, there appeared to be no value in showing the acreage as provided for in the plans. Good conservation practices such as strip cropping, fence row management, and farm ponds, while not designated as wildlife areas, do provide food, cover, and travel lanes for wildlife.

[6]Hill, Elton B., and Russell G. Mawby (1954). Types of farming in Michigan. Mich. Agr. Expt. Sta. Spec. Bul. 206. 80 pp. Some adjustments in boundaries were made to facilitate the summarization of the data.

[7]Whiteside, E. P.; I. F. Schneider and R. L. Cook (1956). Soils of Michigan. Mich. Agr. Expt. Sta. Spec. Bul. 402. 52 pp.

LIMITATIONS OF THE DATA

The farm plans upon which this study was based included plans developed in each year from 1938 through 1955. The greater part of them, however, were developed after 1944. Thus the transition period from the pre-planning phase to the complete establishment phase is not a period common to all plans under study. From 1938 to 1955 changes were made in the standards used in conservation planning. These changes were effected as research, experience, and observation produced new techniques for erosion control and soil improvement. There were also many changing sociological and economic conditions during the 18-year period that exerted influence on land owners in their plans for the use of their lands.

It should not be assumed, therefore, that the indicated percentage changes in land use would be the same percentages that would result if the same lands were all planned in 1958 with present conservation techniques and under 1958 sociological and economic conditions. The trends undoubtedly would be similar, but the extent of the indicated land use changes might well be modified by the above factors.

In conservation farm planning, the objective is to use the land for whatever purpose it is best suited. For example, lands having little or no erosion hazard, generally the most productive, is used for the production of row crops. The end result of such planning would undoubtedly be an increased yield per acre.

This illustrates the fact that the percentage and acreage changes attributed to the effects of conservation planning cannot be directly translated into percentage changes in the output of any farm product. Such an evaluation of the economic effects of conservation planning was not planned as a part of this study.

The data presented here represent net land use changes only.

INTERPRETATION OF THE DATA

A summary of the various land use changes that would be effected in the 16,889,370 acres included in the study following conservation planning are shown in Table 1.

The percentage increases or decreases in acreage as a result of conservation planning are as follows: row crops, –18.04 percent; small grains, –8.22 percent; rotation hay and pasture, +58.97 percent; permanent pasture, –41.19 percent; woodland, +15.62 percent;

TABLE 1—Summary—Planned land use changes and percentage of land devoted to various categories of land use before planning and as planned in 53 Michigan soil conservation districts(a)

Land use	Before planning (acres)	After planning (acres)	Increase or decrease (acres)	Increase or decrease (percent)	Before planning (percent)	After planning (percent)	Increase or decrease (percent)
Row crops	1,890,179	1,549,121	− 341,058	−18.04	11.19	9.17	− 2.02
Small grains	2,609,428	2,394,828	− 214,600	− 8.22	15.45	14.18	− 1.27
Rotation hay and pasture	3,605,687	5,731,839	+2,126,152	+58.97	21.35	33.94	+12.59
Permanent pasture	2,489,363	1,463,875	−1,025,488	−41.19	14.74	8.67	− 6.07
Woodland	3,532,906	4,084,655	+ 551,749	+15.62	20.92	24.18	+ 3.26
Orchard	368,948	409,864	+ 40,916	+11.09	2.18	2.43	+ .25
Truck gardening	104,715	119,156	+ 14,441	+13.79	.62	.70	+ .08
Miscellaneous and idle	2,288,144	1,136,032	−1,152,112	−50.35	13.55	6.73	− 6.82
Total	16,889,370	16,889,370	00	xxxxxxx	100.00	100.00	.00

(a) Source: Unpublished data, erosion and land use studies, Michigan Agricultural Experiment Station.

orchard, +11.09 percent; truck gardening, +13.79 percent; and, miscellaneous and idle, –50.35 percent.

Table 2 presents information on the extent of land use changes, in acres, that would be planned in the various types of farming areas. These data are shown as percentage changes in Table 3.

TABLE 2—Planned acreage changes in land use as a result of conservation farm planning by type of farming area in 53 soil conservation districts

Type of farming area	Row crops	Small grains	Rotation hay and pasture	Permanent pasture	Woodland	Orchard	Truck gardening	Misc. and idle
I	−35990	−18185	+113337	−25522	−22614	−430	−843	−9753
II	−65405	−33052	+334087	−141289	−10449	+1458	+6849	−92199
III	−19684	−9147	+78811	−31903	+45060	+22109	+5481	−90727
IV	−12717	−16976	+83086	−54110	+91428	+4299	+2007	−96967
V	−73138	−53513	+318305	−95000	−37036	−980	+2216	−60854
VI	−25822	−14268	+129556	−36216	+8906	−623	+312	−61845
VII	−15980	−22776	+124061	−57672	+4136	+621	+2114	−34505
VIII	−36017	−8572	+80486	−7647	+623	−31	−6973	−21869
IX	−6896	−3153	+18031	−3755	+8946	....	+241	−13414
X	−31310	−13624	+387893	−283138	+74796	+1528	+1651	−137796
XI	−10138	−11517	+176642	−109734	+108092	+13525	+1194	−168064
XII	−3212	−9224	+114697	−63975	+92511	+1978	+79	−132854
XIII	−6751	+1224	+149257	−113988	+192793	−2267	+209	−220477
XVI	+3296	−2714	+13124	+1650	−6759	−271	....	−8326
XVII	−1294	+897	+4829	−3189	+1316	....	−96	−2463
Total	−341058	−214600	+2126152	−1025488	+551749	+40916	+14441	−1152112

Area I General livestock and corn
Area II Dairy livestock and corn
Area III Southwestern Michigan fruit, dairy, and truck
Area IV Dairy, poultry, and truck
Area V Dairy and general farming
Area VI Dairy, part-time, and truck
Area VII Dairy and cash crops
Area VIII Cash crops and dairy
Area IX General livestock and part-time
Area X Dairy, potatoes, and truck
Area XI Northwestern Michigan fruit and dairy
Area XII Dairy, part-time, and potatoes
Area XIII Forestry, part-time, and cattle
Area XVI Dairy and potatoes
Area XVII Dairy, potatoes, part-time, and forestry

Under "Methods of Analysis," it was indicated that the data were also summarized on the basis of the major Michigan soil associations. The acreage and percentage changes in the various land use categories by soil associations are shown in Tables 4 and 5 respectively.

The data presented in Tables 2 through 5 may be interpreted as follows:

Row Crops: Decreases in the acreages of row crops would result in all type-of-farming areas except XVI, and in all soil associations except 5 and 7 and that portion of soil associations 22 and 26 occurring in the soil conservation districts in the Upper Peninsula. This trend towards increased row crop acreages in the Upper Peninsula area is perhaps a reflection of the fact that many sections of this area are still under development agriculturally.

From an acreage standpoint, the greatest reductions would occur in type-of-farming areas V and II. The largest acreage reductions in row crops would occur in those soil associations occurring in the south central, thumb, and south eastern sections of Michigan. Corn is the dominant Michigan row crop and the area noted above is the main corn growing section of the state. Soil associations that would have the greatest acreage reductions are numbers 34, 39, 36, 20, and 37.

Small Grains: Small grain acreages would be reduced in all type of farming areas except XIII and XVII. In these two areas, minor increases of 1.22 and 3.68 percent, respectively, would be effected. Table 4 indicates that increased acreages would be planned in a number of soil associations. While Table 5 shows the percentage increases to be rather large, an examination of Table 4 shows that the actual acreage changes involved were all quite small except in soil association 27. Here the acreage of small grains would be increased 4,920 acres. The increased acreages in all other associations would total only 3,024 acres. Major decreases in acreages would be indicated in soil associations 34, 36, 39, 31, and 37 (all in southern Michigan).

TABLE 3—Planned percentage change in land use as a result of conservation farm planning by type-of-farming area—in 53 soil conservation districts

Type of farming area	Row crops	Small grains	Rotation hay, and pasture	Permanent pasture	Woodland	Orchard	Truck gardening	Misc. and idle
I.....	−27	−11	+81	−28	−30	−52	−84	−19
II.....	−25	−8	+73	−45	−4	+8	+47	−41
III.....	−28	−11	+75	−45	+39	+13	+20	−68
IV.....	−15	−15	+66	−32	+53	+14	+15	−68
V.....	−19	−10	+48	−26	−14	−13	+13	−24
VI.....	−20	−8	+51	−29	+7	−4	+7	−34
VII.....	−11	−12	+52	−54	+4	+8	+21	−35
VIII.....	−18	−4	+69	−39	+1	−100	−95	−32
IX.....	−53	−16	+71	−49	+88	....	+305	−53
X.....	−16	−5	+73	−69	+17	+15	+89	−52
XI.....	−11	−9	+68	−65	+33	+16	+46	−65
XII.....	−6	−9	+50	−46	+21	+13	+4	−68
XIII.....	−12	+1	+56	−34	+32	−21	+12	−67
XVI.....	+11	−5	+10	+2	−2	−18	....	−20
XVII.....	−6	+4	+7	−4	+1	....	−100	−9
Total...	−18	−8	+59	−41	+16	+11	−14	−50

Area I General livestock and corn
Area II Dairy livestock and corn
Area III Southwestern Michigan fruit, dairy, and truck
Area IV Dairy, poultry, and truck
Area V Dairy and general farming
Area VI Dairy, part-time, and truck
Area VII Dairy and cash crops
Area VIII Cash crops and dairy
Area IX General livestock and part-time
Area X Dairy, potatoes, and truck
Area XI Northwestern Michigan fruit and dairy
Area XII Dairy, part-time, and potatoes
Area XIII Forestry, part-time, and cattle
Area XVI Dairy and potatoes
Area XVII Dairy, potatoes, part-time, and forestry

TABLE 4—Planned acreage changes in land use as a result of conservation farm planning by major Michigan soil associations in 53 soil conservation districts

Major Michigan soil associations	Row crops	Small grains	Rotation hay and pasture	Permanent pasture	Woodland	Orchard	Truck gardening	Misc. and idle
3.....	−15	+36	+130	....	−125	....	....	−26
5.....	+52	+316	+1497	+1101	−2411	....	....	−555
7.....	+1587	−587	+1225	+327	−651	....	....	−1901
9.....	−457	+915	−266	....	−115	....	−96	+19
13.....	−875	+700	+175	....	....	....	....	....
19.....	−7812	−14057	+146422	−103329	+9731	−216	+1635	−32374
20.....	−35307	−9604	+74446	−15266	+3301	−22	+35	−17583
21.....	−4656	−135	+14510	+489	−1054	....	−4169	−4985
22.....	−16202	−14268	+93785	−45134	+14097	+4728	+1082	−38088
22 (U.P.)....	+3131	−2590	+9863	+1442	−4097	−271	....	−7478
25.....	−7324	−1506	+30271	−8248	+30529	+2622	−3294	−43050
26.....	−6226	−10998	+168438	−116488	+53171	+2020	+70	−89987
26 (U.P.) ...	+101	+56	+2912	−31	−2572	....	....	−466
27.....	−20924	+4920	+290633	−205300	+98594	+10326	+295	−178544
28.....	−18076	−15991	+152112	−122638	+355945	−144	+1879	−353087
29.....	−7475	−15282	+129159	−60320	+48076	+1572	+1536	−97266
31.....	−15730	−21719	+83377	−22275	−6213	+5731	−196	−22975
32.....	−18417	−11152	+68691	−21942	−9318	−652	....	−7210
34.....	−50729	−28285	+228583	−75820	−14819	+3803	+885	−63618
35.....	−9220	−503	+26050	−6153	−6268	....	−504	−3402
36.....	−35343	−23914	+162315	−56689	−24798	+2490	+2389	−26450
37.....	−29300	−21292	+183549	−73574	−16086	−906	+1209	−43600
38.....	−1427	−949	+12300	−6964	−2	+142	....	−3100
39.....	−38968	−22471	+193891	−77294	+17862	+581	+770	−74371
40.....	−10634	−1026	+13930	+1169	−941	+1417	−819	−3096
41.....	−6843	−4268	+18102	−5516	+11780	+6151	−241	−19165
42.....	−155	+1001	−594	−79	+3481	+1800	−19	−5435
43.....	−3814	−1947	+20646	−6956	−5348	−256	+11994	−14319
Total...	−341058	−214600	+2126152	−1025488	+551749	+40916	+14441	−1152112

Rotation Hay and Pasture: Rotation hay and pasture would be increased in all type of farming areas. The two areas in the Upper Peninsula, XVI and XVII, would have rather small increases of 10.11 and 7.22 percents, respectively. Increased acreages in all other areas would be near 50 percent or greater. Table 4 indicates that the planned increases in the Upper Peninsula soil associations 3, 5, 7, 13, and 22 would be relatively minor.

The only Upper Peninsula soil association showing a major increase would be 26. Soil association 9, also in the Upper Peninsula, would be planned for a slight decrease in the acreage of rotation hay and pasture as would soil association 42 in southwestern Michigan. All other associations would have greatly increased rotation hay and pasture acreage.

Permanent Pasture: The permanent hay and pasture acreage would be increased by 2 percent in type-of-farming area XVI. All other

areas would have greatly reduced acreages. Increased acreages would result in soil associations 3, 5, and 7 (all in the Upper Peninsula) as well as that portion of soil association 22 occurring in the Upper Peninsula. Such increases would result in the acreage shifts noted above for type-of-farming area XVI. Soil association 40 in southeastern Michigan would also be planned for a greater acreage of permanent pasture.

All other type-of-farming areas and soil associations would have reduced acreages as more productive usages were sought for the land formerly devoted to permanent pastures which generally are of the relatively unproductive bluegrass type. The greatest acreage decreases would be in the sandier areas of western, northwestern, and northern Michigan (soil associations 28, 27, 29, and 26).

TABLE 5—Planned percentage change in land use as a result of conservation farm planning by major Michigan soil associations—in 53 soil conservation districts

Major Michigan soil associations	Row crops	Small grains	Rotation hay and pasture	Permanent pasture	Woodland	Orchard	Truck gardening	Misc. and idle
3	−2	+4	+4	....	−2	....	....	−3
5	+1	+3	+5	+6	−3	....	....	−4
7	+45	−20	+14	+2	−2	....	....	−31
9	−17	+36	−3	....	−2	....	−100	+1
13	−25	+22	+2	....	....	....	....	....
19	−8	−9	+64	−58	+10	−1	+115	−36
20	−23	−6	+59	−53	+12	−100	+10	−35
21	−10	....	+230	+326	−13	....	−100	−45
22 (L.P.)	−16	−10	+45	−49	+11	+15	+59	−49
22 (U.P.)	+14	−5	+9	+2	−1	−18	....	−21
25	−13	−3	+44	−39	+60	+30	−77	−63
26 (L.P.)	−9	−9	+73	−60	+21	+13	+14	−61
26 (U.P.)	+4	+2	+46	−1	−11	....	....	−29
27	−16	+3	+66	−66	+15	+18	+6	−59
28	−20	−12	+55	−33	+49	−1	+42	−73
29	−9	−12	+81	−47	+17	+17	+13	−56
31	−18	−16	+56	−26	−10	+21	−7	−38
32	−24	−12	+85	−64	−25	−63	....	−20
34	−18	−7	+47	−32	−8	+16	+7	−33
35	−31	−1	+66	−17	−41	....	−25	−21
36	−21	−11	+61	−34	−19	+30	+34	−27
37	−19	−9	+70	−42	−13	−3	+24	−35
38	−14	−5	+82	−66	....	+34	....	−35
39	−26	−10	+60	−36	+9	+1	+6	−36
40	−45	−5	+111	+50	−16	+16	−65	−59
41	−47	−24	+98	−53	+40	+16	−3	−70
42	−13	+95	−10	−7	+100	+10	−1	−58
43	−16	−7	+69	−21	−15	−26	+71	−43
Total	−18	−8	+59	−41	+16	+11	+14	−50

Woodland: Table 2 shows that woodland acreages would be increased in all type-of-farming areas except XVI, II, V, and I with the greatest percentage decrease planned for area I (30 percent). The soil associations where woodland acreages would be substantially increased are 28, 27, 26, and 29. These associations were planned for greatly reduced acreages of permanent pasture; it will be shown later that the same associations would also be planned for greatly reduced acreage devoted to miscellaneous and idle uses. Undoubtedly much of the land being diverted to woodland was land utilized for permanent pasture and for miscellaneous and idle purposes.

Orchard: Acreages utilized for orchard purposes would be increased in a number of type-of-farming areas. Those areas along Lake Michigan, constituting the major Michigan fruit section, would be planned for the greatest increased orchard acreages (areas III, XI, and IV). Major increases in acreages naturally would occur in the soil associations occurring within the above type-of-farming areas. The associations are 27, 41, 31, 22, 34, 25, and 36.

Truck Gardening: Present truck gardening acreages would be maintained in area XVI; decreased in areas I, VIII, and XVII, and increased in all other areas. As far as changes in acreages in soil associations are concerned, the greatest increases would occur in numbers 43, 36, 28, 19, and 29. The greatest increase would be effected in the organic soil association (43). Major decreases would result in associations 21 and 25 — largely in the thumb area.

Miscellaneous and Idle: Changes in land devoted to this use were most consistent in direction within the type-of-farming areas and in the soil associations. All type-of-farming areas and all soil associations except 9 and 13 would be planned for smaller acreages of land utilized for miscellaneous and idle purposes.

In soil association 13, the present acreage would be maintained, while a .72 percent increase would be indicated for soil association 9. This trend in greatly reduced acreages for miscellaneous and idle purposes would result in the diverted acreages being used for purposes more likely to produce income for the farm. Major acreage reductions would be in soil associations 28, 27, 29, and 26.

CONCLUSION

As was stated earlier, this study was concerned only with the changes in land use that would be effected by conservation farm planning. No attempt was made to determine the shift in acreages of individual crops that would be brought about, and consequently, no effort was made to evaluate the effects of such planning on the total production of any agricultural commodity.

Fairly consistent trends are noted in the land use changes that a general adoption of conservation plans would bring about. Over most of the area of the state there would be large reductions in the use of land for unproductive permanent pastures and miscellaneous and idle purposes. In many areas substantial acreages of land being used for such purposes would be reforested.

Acreages of row crops and small grains generally would be reduced; the acreages of rotation hay and pasture generally would be increased. Orchard acreages would be increased in the fruit section of the state, and truck gardening would come in for additional acreages, particularly on the organic soils well adapted for such production. Woodland acreages also would be increased.

It is recognized that additional new effective techniques for soil management and erosion control have been developed since many of the conservation farm plans included in this study were prepared. Soil management practices such as minimum tillage and a better use of crop residues have contributed to the modification of conservation planning standards. Such practices frequently permit a more intensive cultivation of the land than was possible under planning standards that were used in the preparation of many of the plans under study.

The fact that these more recently developed practices could not be considered in this study, however, detracts nothing from the significance of the study results in pointing out the nature of the land use problems that must be overcome in conservation farm planning.

The study indicated that conservation farm planning, using planning standards that were currently acceptable, would result in an 18.04 percent reduction in the acreage of row crops. This was necessary because, in overcoming problems of soil erosion and loss of organic matter, more frequent use of the land for soil building crops was needed.

Today, minimum tillage and greater use of crop residues are practices which serve to facilitate the maintenance of organic matter and are effective erosion control practices. Their use in conservation planning would undoubtedly serve to lessen the indicated reduction in the use of land for row crops, and at the same time lessen the extent of the increase in rotation hay and pasture.

It is not likely, however, that the indicated trends in use of land for other uses would be significantly affected by the newer soil management techniques.

NEW MATERIALS AS COTTONTAIL REPELLENTS

By DON W. HAYNE[1] and H. A. CARDINELL[2]

INTRODUCTION

THE DAMAGE DONE to young trees by cottontail rabbits (*Sylvilagus floridanus mearnsii*, Allen) which eat the bark and cut off small branches, and the control of this damage by repellents, have often been discussed. Formerly (4, 5) we have commented upon the situation in Michigan with special reference to orchards in winter. Eadie (6) summarized the information on damage and its control separately for the different kinds of rabbits of the United States. In a recent report, Hildreth and Brown (10) assembled widely scattered reports of rabbit damage in Europe and in North America along with equally diffuse information on the effectiveness of repellents. This last study includes many references of historical interest.

The present paper reports tests of repellents for winter use against cottontail rabbits in Michigan, as carried out at East Lansing during the winter of 1955-56.

RECENT WORK ON REPELLENTS

Much of the most active recent work on rabbit repellents, that carried out by the Fish and Wildlife Service of the United States Department of the Interior, remains unpublished though available as mimeographed reports and releases (1). Certain interesting work in England (3, 15, 16) is helpful with regard to methods, though the kind of rabbit differs from that in Michigan.

The most extensive publication on work in the U. S. is that of Hildreth and Brown (10) who summarize some 22 years of work at

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the Cheyenne, Wyoming, Horticultural Field Station of the United States Department of Agriculture (U.S.D.A.). Their tests were of two kinds: earlier studies where many rabbits were driven into a 1.7-acre enclosure by CCC labor; and certain later investigations where treated pieces of carrot on the ends of stout wires were exposed in areas where rabbits were present. They also report tests of the phytotoxicity of the candidate repellents.

These authors conclude that among those tested, practical and effective repellent mixtures include only mixtures of asphalt emulsion and nicotine or nicotine sulfate, and mixtures of asphalt emulsion and an organic chemical, thiram. Popular recommendations to this effect have been broadcast as an extension-type folder of the U.S.D.A. (11), unfortunately without due caution as to possible regional or specific limitations on the applicability of the findings.

The findings of Hildreth and Brown differed from our own (5) in several particulars, most importantly as follows:

1. We reported a mixture of rosin and ethyl alcohol as effective, they did not find it useful.

2. We found nicotine sulfate in asphalt emulsion of lesser repellency, they found it highly effective. They also found, however, that in order to mix the two constituents with success, it is necessary to use certain stabilizing additives; otherwise the emulsion is broken. Thus, our previous tests of this mixture probably were carried out with a preparation having a broken emulsion and were prossibly thereby less effective, as Hildreth and Brown pointed out.

3. Mixtures containing thiram, reported by Hildreth and Brown as highly effective, had not been tested by us.

It is not surprising to observe differences in findings of two studies, especially considering the difference in kinds of rabbits involved. We noted (4) for example, that the rosin-alcohol mixture, which has proven generally effective against cottontail rabbits in Michigan and in other eastern states (7), is not repellent to the snowshoe hare *(Lepus americanus)* of northern Michigan.

Hildreth and Brown state that in their tests jack rabbits predominated; they seem to feel that at the same time both the white-tailed and the black-tailed forms (*Lepus townsendii* and *Lepus californicus)* were present along with a few cottontails. Regardless of which of two possible species of cottontails may have been present in these Wyoming tests, it is clear from the known distribution of the various forms (2,

8, 14), that the eastern cottontail *(Sylvilagus floridanus)* found in Michigan, could not have been involved.

Our view of the action of a repellent was presented in a previous paper (5). Briefly, all of the kinds of food locally available to a rabbit population, in and near an orchard, for example, can be thought of as ranked according to acceptability to the rabbits. An effective repellent is one which, when applied, can move some valued plant from near the top to the bottom of that list.

In our experience, repellency cannot be measured in the abstract. Thus, pen tests of repellents can only establish the rank order of the treated material in relation to other materials known to be low in acceptability. If the test is severe enough, it seems probable that any nontoxic and ingestible material, no matter how repellent, will be accepted to some degree by cottontail rabbits.

Field trails must eventually be carried out before a repellent is proved useful. But field trials must be long-term in view, since conditions in the field are only rarely as severe as those readily produced in pens.

METHODS

The present trials were carried out in two series during January, February, and March, 1956. Locally-captured cottontail rabbits were confined in an enclosure measuring 25 by 35 feet on the university farm (Fig. 1). Between two and four animals were present at any one time; a total of 10 were used in the entire series. During the tests, food was restricted to simulate the extreme winter food shortage which presumably accompanies damage to trees.

Treatments were applied to freshly-cut, 3-foot lengths of 1-year old apple shoots, from ⅜- to ¾-inch in diameter. Application was by brush unless otherwise stated. After drying briefly, the shoots were fastened to the pen netting (Fig. 2). They were arranged as eight randomized blocks, two per pen side. For each shoot, daily estimates were made of the percentage of bark removed from a marked 12-inch record zone which ended about 6 inches from the lower end of the shoot.

As the test progressed, the bark treated with the more-tolerated repellents was consumed, making each successive night a more severe test, and furnishing a ranking of the repellents in order of effectiveness. As standards, untreated wood and that coated with each of

Fig. 1. Enclosure used for the trials. A band of muslin along the fence base prevents rabbits from running head-on into the netting. Rabbit hutches were discarded ice-refrigerators, placed doors up and entrance holes cut in the bases. These proved to be most convenient in removing bedding and dead rabbits and in keeping sustaining food dry.

three dilutions of the rosin-alcohol mixture were included, as in previous work (5). The three dilutions of rosin-alcohol were respectively 1 to 8, 1 to 2, and 2 to 1, by weight.

The results of these tests are stated, according to the lowest concentration of rosin-alcohol mixture from which the candidate material could not be distinguished by the statistical test used, with the further provision that it must not rank significantly below the class in which it was included. These classes are discussed below.

Statistical testing was carried out as a series of eight paired comparisons, considering rank of attaining a given degree of damage. To be judged superior, all eight comparisons had to conform (type I error .008); to be judged inferior, at least seven of eight comparisons had to be in the one direction (type II error .078).

The approximate amount applied for certain of the repellent materials was determined by weighing two 5- by 7-inch library cards for each material. Each card was coated with repellent on one side, then dried and re-weighed. The repellent coating was applied by brush or spray, one or two coats as appropriate, and control cards were weighed. The amounts deposited in grams per square centimeter are

Fig. 2. Treated sticks attached to the poultry netting. Shown here are: Left, aluminum foil; center, TN2500, painted on; right, stick with all bark consumed—which had been coated with asphalt emulsion and detergent.

noted in the lists of materials tested in the following section. These determinations were subject to a standard error of about 5 percent.

RESULTS

The results of the tests are stated here, as in previous work (5), by grouping the materials into three classes: Class I, recommended for use, Class II, perhaps promising, and Class III, worth no further attention. The figures following the ingredients state the proportional parts by weight. In parentheses is stated the weight in grams of solids deposited per square centimeter of area. Each component is identified at its first listing.

Group I

The following mixtures are the best of those tested; they did not fail against the cottontails except after extremely severe conditions were imposed. Any repellent in this group is as good as the rosin 2, ethyl alcohol 1, mixture.

Rosin 2, ethyl alcohol 1 (.080 gm. per sq. cm.)

Aluminum foil, household freezer weight, wrapped twice loosely around and crumpled to the stick. The wrapping became torn from a small part of the record section of one of the eight sticks early in the test, but although the rabbits ate the bark thus uncovered, they did not tear the foil farther. McCabe (12) describes successful use of an expanded aluminum foil.

Castle Chemical Rodent Repellent, a commercial repellent of the Castle Chemical Company, Castle Rock, Minnesota.

Ringwood Repellent applied as follows:

1. Painted on (.012 gm. per sq. cm.)
2. Sprayed once (.014 gm. per sq. cm.)
3. Sprayed, dried, sprayed again (.031 gm. per sq. cm.)

This is trinitrobenzene-aniline complex 5 percent, inert ingredients 95 percent, "protects dormant deciduous trees and shrubs from rabbit damage," manufactured by Ringwood Chemical Corporation, Ringwood, Illinois.

TN2500, painted on as supplied (.025 gm. per sq. cm.), a water-dispersible material furnished by the U. S. Fish and Wildlife Service, with label "TN2500 Dispersion, TN2500 10 percent. Phoplex AC-33 solids 15 percent, control No. E-12910.1, Ringwood Chemical Corporation, Ringwood, Illinois."

Thiram in the following mixtures (see references 10 and 11):

1. "Tersan 75" 10, asphalt emulsion 85, water 87 (.039 gm. per sq. cm. of which .006 gm. per sq. cm. calculated as thiram).
2. "Tersan 75" 10, asphalt emulsion 39, water 42 (.038 gm. per sq. cm. of which .010 gm. per sq. cm. calculated as thiram).
3. "Arasan SF-X" 10, asphalt emulsion 13, water 75, sprayed on (.015 gm. per sq. cm. of which .007 gm. per sq. cm. calculated as thiram).
4. "Arasan SF-X" 10, asphalt emulsion 13, water 28 (.164 gm. per sq. cm. of which .074 gm. per sq. cm. calculated as thiram).

"Tersan 75" and "Arasan SF-X" products of E. I. duPont de Nemours and Company, Inc., Grasselli Chemicals Department, Wilmington, Delaware, are each stated to contain an active ingredient 75 percent thiram as a wettable powder, tetramethylthiuramdisulfide.

The asphalt emulsion used was Carey Super Ebontex and contained 50 percent solids.

Tre-tex (Tre-tex Company, Shelbyville, Indiana) a commercial repellent.

The material z.i.p., applied as follows:

1. z.i.p. (zinc dithiocarbamate amine complex in polyethylene polysulfide) paste 12, water 7. This mixture washed off readily, but the inconspicuous traces remaining repelled the rabbits.

2. z.i.p. paste 12, asphalt emulsion 10, water 16 (.028 gm. per sq. cm. of which .018 gm. per sq. cm. calculated as z.i.p. solids).

3. z.i.p. paste 12, asphalt emulsion 10, detergent 1, water 16 (.028 gm. per sq. cm. of which .017 gm. per sq. cm. calculated as z.i.p. solids).

The detergent was Tide, of Proctor and Gamble.

Our stock of z.i.p. was a paste, 78 percent solids, "Goodrite z.i.p. March 1, 1949, Code: 3946X12" supplied by B. F. Goodrich Chemical Company, Cleveland, Ohio. (We are informed that distribution of this material is now by Larvicide Products, Inc., Ringwood, Illinois.)

Group II

The following are mixtures which must be rated as having at least moderate protective ability as shown by the tests. In case of doubt as to whether a mixture should be placed in this group or in the group of the best mixtures, it was always placed in this group. The standard in this group is the rosin 1, ethyl alcohol 2, mixture.

Rosin 1, ethyl alcohol 2 (.030 gm. per sq. cm.)

Asphalt emulsion alone (.073 gm. per sq. cm.) (See under thiram above).

Nicotine sulfate 20, detergent 10, asphalt emulsion 79, water 126 (.044 gm. per sq. cm.). The nicotine sulfate was "Black Leaf 40" brand, Tobacco By-Products and Chemical Corporation, Richmond, Virginia.

Actidione in asphalt emulsion, 550 p.p.m., wet weight (.080 gm. per sq. cm. calculated 1,100 p.p.m. dry weight). Actidione from the Upjohn Company, Kalamazoo, Michigan.

TN 2500 #11, water 30, a spray mixture, applied as follows:

1. sprayed once (.005 gm. per sq. cm.)
2. sprayed, dried, sprayed again (.010 gm. per sq. cm.)

Group III

The following are mixtures ranging from those of some ability, but of less than Group II, down to those of no apparent value.

Rosin 1, ethyl alcohol 8 (.008 gm. per sq. cm.)

Asphalt emulsion 79, detergent 10, water 126 (.020 gm. per sq. cm.)

Ryanicide 34, asphalt emulsion 79, water 209, detergent 10. This insecticide was included because of the reported low oral toxicity rating for rabbits, and exemption from tolerance requirements. "Ryanicide 100" brand, S. B. Penick and Company, New York 8, New York.

DISCUSSION

Water is a more practical diluent for a repellent than are any of the volatile solvents, except when temperature requires anti-freeze mixtures. The following water-dispersible repellents were highly effective in these tests: thiram in asphalt emulsion, z.i.p. alone or in an asphalt emulsion, and the product TN2500. The following effective repellents require a volatile diluant: rosin-alcohol mixture, Castle Chemical repellent, Tre-tex, trinitrobenzene-aniline complex (Ringwood Repellent), and from previous work, Formula 96-A of the Fish and Wildlife Service (5).

Mixtures containing thiram were highly effective, our tests against cottontails agreed in this instance with those of Hildreth and Brown against jack rabbits. Varying the amount of thiram over a 12-fold range did not change the apparent effectiveness within the discriminating power of our tests, although Hildreth and Brown report otherwise for theirs. Mixtures containing thiram promise to be very useful, assuming the continued availability of the active ingredient.

That z.i.p. was effective in our tests either alone or mixed with asphalt emulsion is in disagreement with the findings of Hildreth and Brown, who list this material as, at best, only slightly repellent against western rabbits.

While the composition TN2500 was effective when the original mixture was brushed on, as a spray of one-quarter strength it was clearly less effective. Whether an effective single coating can be

sprayed on was not determined. Hildreth and Brown did not report on this mixture.

Because the rosin-alcohol mixture served as the standard material, it could not be rated in the same manner as the other repellents. However, to all appearances, it retained the effectiveness shown previously in pen and field tests. The Castle Chemical repellent also continued to be effective. Hildreth and Brown report concerning these two materials, respectively, "not repellent when applied to carrots" and "slight repellency".

Similarly the trinitrobenzene-aniline complex (Ringwood Repellent) and the Fish and Wildlife Service Formula 96-A, effective in our tests against cottontails, are reported by Hildreth and Brown as, respectively, of "fair repellency" and "not effective in repelling rabbits when applied to carrots."

While we have observed in previous tests that nicotine sulfate in asphalt emulsion is not of highest repellency against cottontails, there was the possibility that the breaking of the emulsion destroyed the effectiveness of this mixture. However, in the present series of tests, using the recommended additive, we obtained very similar results. In contrast, Hildreth and Brown found the mixture highly effective against jack rabbits.

It is of interest to examine the results from testing the separate components of this mixture. The asphalt emulsion itself possessed moderate (Group II) repellency in this series. In our previous experience, the asphalt emulsion then in use was so readily accepted by cottontails that discrimination between untreated wood and that coated with asphalt emulsion was negligible. We assume the difference is related to a change in the kind of asphalt emulsion available. It is not clear, however, from our tests, whether the nicotine sulfate actually had any repellent action of itself, or whether it functioned only to change the physical nature, perhaps viscosity, of the mixture. Below are listed, in order of effectiveness, the three pertinent mixtures and the amount of material deposited by each.

Most effective—asphalt emulsion alone—.073 gm. per sq. cm.

Intermediate—complete mixture—asphalt emulsion, nicotine sulfate, detergent—.044 gm. per sq. cm.

Least effective—asphalt emulsion and detergent—.020 gm. per sq. cm.

Each difference in effectiveness is statistically significant. Addition of the detergent seems to have decreased the amount of material

deposited as well as the effectiveness of the coating of asphalt emulsion. Further addition of the nicotine sulfate increased both the weight of coating and the effectiveness over those of the asphalt emulsion with detergent, but did not raise these characteristics to equal those of the asphalt emulsion alone.

The differences between results reported by Hildreth and Brown and those observed in our study emphasize the importance of considering the kind of rabbit involved when testing and recommending repellents. Certain early workers (9) even used domesticated rabbits (originally derived from the European rabbit, *Oryctolagus cuniculus*), to test cottontail repellents. The bases for food likes and dislikes among rabbits are not well known. The relative importance of possibly innate preferences, in contrast to learning and experience with the plants available is in doubt. Whatever the nature of these differences between species they do seem to exist in fact. It therefore seems important to test repellents against the kind of rabbit present where the materials will be used.

SUMMARY

The list of materials tested as repellents against the cottontail rabbit in Michigan has been expanded somewhat and several effective

Recommended formulae in common units:

Thiram: Mix 1 gallon of asphalt emulsion and 1 gallon of water, add 1 pound of thiram as wettable powder either "Tersan 75" or "Arasan SF-X" or like product with 75 percent thiram. Apply with brush.

z.i.p.: Mix 1 gallon of asphalt emulsion and 1½ gallons of water, add 10 pounds z.i.p. paste. Apply with brush. Probably the amount of z.i.p. could be reduced with safety, but a lesser concentration was not tested.

Rosin: To 1 gallon of ethyl alcohol, add 7 pounds of crushed rosin. Allow the mixture to stand in a closed container overnight in a warm room to dissolve the rosin. Apply with brush.

new materials are listed. Of particular promise are certain water-dispersible materials, including thiram and z.i.p., each of which is mixed with asphalt emulsion, and the experimental material TN2500. Aluminum foil seems useful.

Certain differences were observed in comparing the results of this study with that of Hildreth and Brown carried out in Wyoming principally against jack rabbits. It is concluded that repellents should be tested against the kind of rabbit for which their use is recommended.

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MICHIGAN'S PRODUCTION POSITION FOR AGRICULTURAL COMMODITIES

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IS MICHIGAN HOLDING ITS OWN as an agricultural producing state? Data for the past 28 years indicate that in the production of many important agricultural products the state is falling behind when compared to the rest of the nation. This may or may not be to the benefit of our society.

Many people argue that the theory of comparative advantage and a competitive price system will locate production in those areas which maximize the efficient use of resources or minimize the cost of producing the nation's total output of each commodity. However, agricultural producers do not operate under an unregulated price system, and it is not easy to evaluate what the comparative advantages of an area producing a particular commodity are or will be in the future.

Control programs, whether on production or price, upset the competitive price structure by shifting the location of production and changing the competitive position of areas. Comparative advantages are not always a result of natural elements but are amenable to change by man. Research programs which improve technology permit regional specialization and offer particular areas comparative advantages for limited periods of time. The successful use of irrigation waters on arid areas of Arizona and California, or the advent of Brahma and Charbray cattle suitable to Florida's climate, are examples of such technologies.

New technologies in turn can shift production to other areas. This article deals with production patterns in Michigan over the past three decades for 19 agricultural commodities. The absolute levels of production for Michigan are compared to those of the United States for 1929-57. From these data can be deduced the production position of Michigan relative to the nation.

ART. 41-10

In 1956, 19 commodities made up approximately 83 percent of cash receipts from farm marketings in Michigan.[1]

The production pattern for each of the 19 commodities is presented and is accompanied by a short discussion of the state and national relationships. Rather than trace annual production changes for the 19 commodities, the data are aggregated to be representative of production during a longer time period. Production for the years 1929-31 are averaged for each of the commodities and used as a basing point. Similarly the years 1939-41, 1949-51, and 1955-57 are also averaged. Three year averages are used to eliminate the selection of any one unusual production year and to survey relative production changes. (See appendix.)

To keep the production position of the state in perspective, population data should also be considered. Michigan's population, as well as the nation's in total, has increased continuously over the past 3 decades. However, a larger percentage of the population has become established in Michigan. According to census data, Michigan had 3.94 percent of the national population in 1930, 3.99 percent in 1940 and 4.24 percent in 1950, increasing to 4.46 percent in 1956.

ANALYSIS BY COMMODITIES

Livestock and Livestock Products

Milk: Milk production in Michigan, as well as for the nation, has increased absolutely over time. Relatively, the state increase rate during the thirties and forties exceeded that for the nation. During the fifties it fell behind the national rate. (See Tables 11 and 12 for the absolute and relative production changes for Michigan and the United States.) Michigan production as a percent of the total was 4.1 percent in 1929-31, 4.5 percent in 1939-41, 4.6 percent in 1949-51, and 4.4 percent in 1955-57. It has never been out of the range of 4 to 5 percent of total production since 1929.

Cattle and Calves: During the thirties live weight production of cattle and calves in Michigan increased relatively more rapidly than for the rest of the nation. While there continued to be an absolute production increase during the forties and fifties the rate did not match that for the nation. In 1939-41 Michigan was producing 2.4 percent of

[1]Data for the production of these commodities are taken from *Agricultural Statistics* (AMS, U.S.D.A.) as far as is possible. For the years 1955-57 crop data are from the annual summaries of *Crop Production* (AMS, U.S.D.A.). Livestock production data for the years 1953-57 are from the respective commodity situation reports as published by the Agricultural Marketing Service.

TABLE 1—Percentage(a) changes in U. S. and Michigan production for 19 commodities

Commodity	Percent change					
	Ave. (1929-31 — 1939-41)		Ave. (1939-41 — 1949-51)		Ave. (1949-51 — 1955-57)	
	Mich. %	U.S. %	Mich. %	U.S. %	Mich. %	U.S. %
Milk	21.0	9.6	8.5	4.9	1.7	7.6(a)
Cattle and Calves	43.8	21.6	5.0	32.4	17.8	33.0(a)
Hogs	52.2	9.1	−2.6	18.4	−7.1	−4.8(a)
Sheep and Lambs	−18.8	9.2	−59.6	−37.6	7.1	19.5(a)
Wool	−16.5	6.2	−60.6	−41.5	−5.4	6.2(a)
Broilers	....	....	185.0	338.1	100.8	89.3(a)
Eggs	8.7	4.3	21.0	43.8	8.4	4.4(a)
Chickens	−13.7	−9.9	−.6	−7.9	−33.2	31.3(a)
Turkeys	81.7	86.9	98.9	39.2	8.0	61.6(a)
Corn (all)	57.1	7.2	32.7	20.1	34.8	9.2
Winter Wheat	1.7	−10.5	89.2	22.8	−7.2	−4.3
Oats	15.8	−3.6	11.0	14.2	−20.3	2.8
Soybeans	....	....	82.3	196.8	119.9	69.5
Sugar Beets	120.2	36.4	−23.0	2.7	5.0	18.7
Potatoes	6.1	1.3	−29.3	7.7	−22.2	1.8
Cherries	....	....	115.7	66.6	−10.8	−3.7
Apples	46.2	−8.7	14.8	−1.0	5.0	−12.4
Peaches	130.0	9.9	−.7	−7.9	−18.0	1.8
Truck Crops	....	....	....	....	10.9	13.2(a)

(a) Indicates averages for 1955-56.

the nation's beef and 1.9 percent in 1949-51. By 1955-56 this had dropped to 1.7 percent. Part of the reason is the decline in dairy cow and veal calf numbers which are important in Michigan and are included in beef production. It is important to note the decline in beef production occurred while the state shifted to a surplus area for feed grains.[2]

Hogs: Hog production typically fluctuates with feed grain prices. In Michigan, production increased absolutely and relatively from 1929-31 to 1939-41. However, since that time state production has fallen both absolutely and relatively. In 1929-31 the state produced 1.3 percent of the hogs, in 1939-41, 1.8 percent, 1.5 percent in the period 1949-51, and 1.4 percent for the 1955-56 period. There are no apparent reasons for the decline. Certainly, feed supplies for the state have been adequate and prices for both hogs and feed have not differed relatively as compared to the Corn Belt and hog producing states.

[2]Wright, K. T. (1956). Feed grain production and livestock production in Michgan. Agr. Expt. Sta., Mich. State Univ., Spec. Bul. 407.

TABLE 2—Michigan production as a percentage of U. S. production, by commodities, averaged for the years 1929-31, 1939-41, 1949-51, 1955-57

Commodity	Time period			
	1929-31	1939-41	1949-51	1955-57
	Percent	Percent	Percent	Percent
Milk	4.06	4.48	4.63	4.38
Beef Cattle and Calves	2.02	2.39	1.89	1.67(*c*)
Hogs	1.27	1.78	1.46	1.43(*c*)
Sheep and Lambs	3.29	2.44	1.58	1.42(*c*)
Wool	2.41	1.90	1.28	1.14(*c*)
Broilers	na	.54	.35	.38(*c*)
Eggs	3.06	3.19	2.68	2.78(*c*)
Chickens	2.79	2.67	2.88	2.80(*c*)
Turkeys	1.48	1.44	2.06	1.37(*c*)
Corn (all)	1.42	2.08	2.30	2.84
Winter Wheat	2.41	2.73	4.21	4.09
Oats	3.69	4.43	4.31	3.34
Soybeans	na	1.23	.76	.98
Sugar beets	5.71	9.22	6.92	6.12
Potatoes	5.20	5.44	3.57	2.73
Cherries	21.67(*a*)	45.20	58.55	54.25
Apples	4.24	6.78	7.85	9.40
Peaches	2.39	4.99	5.06	4.08
Vegetables	na	2.79(*b*)	3.05	2.98

(*a*) All cherries 1929-31. Sour cherries for other periods.
(*b*) Average acreage 1939-41.
(*c*) Average for 1955-56.

Sheep and Lambs Wool: Michigan sheep and lamb production has tended to decline during the past three decades both absolutely and relative to the rest of the nation. During the last few years absolute production has leveled off, and in the 1949-51 and 1955-57 periods Michigan produced about 1.5 percent of the sheep and lambs and 1.2 percent of the nation's wool. The wool incentive payments probably help to account for this leveling. This compares with over 3 percent of the nation's sheep and lambs in 1929 and 2.4 percent of the wool.

Eggs: Michigan egg production has increased fairly constantly since 1929. The same is true for the United States although for the past two decades the rate for the nation has been higher. This has meant that Michigan's percent of total production rose from 3 percent in 1929-31 to 3.2 percent in 1939-41 and then dropped to 2.7 percent in 1949-51

and 2.8 percent in 1955-57. The relatively slower rate for the state has been partially a result of regional specialization of egg production in sections of the southeastern states and California.

Broilers: Michigan broiler production has never reached 1 percent of the national total since data have been available. While production in the state has continued to increase in total pounds it has fallen off relative to the national total. It moved from about .5 percent in 1939-41 to .4 percent in 1949-51 and 1955-57.

Other Poultry Meat: Chicken meat production has declined in Michigan and in the United States with Michigan's relative position being fairly constant. The move to specialized broiler production and improved rates of lay per hen probably account for this trend. Turkey production like broiler production has increased for both the state and the nation. Only during the forties did the rate of increase in Michigan surpass that for the nation. From 1949-51 to 1955-57 it declined from 2.1 percent to 1.4 percent.

Crops

Corn: Corn production in Michigan has continued to expand. The 1929-31 average state production was about 34 million bushels while the 1955-57 production approximated 95 million bushels. The rate of increase for the state has exceeded that for the nation. In 1929-31 Michigan production was 1.4 percent of the total. In 1939-41 it jumped to 2.1 percent, to 2.3 percent in 1949-51, and to 2.8 percent in 1955-57.

Oats: Oat production in Michigan has been erratic in nature. It has varied from a low of about 23 million bushels in 1944 to a high of 69 million bushels in 1946. State production relative to total production was 3.7 percent for 1929-31, 4.4 percent for the 1939-41 period, 4.3 percent for the 1949-51 period, and 3.3 percent for the years 1955-57.

Winter Wheat: Wheat production in Michigan held fairly constant at about 18 million bushels until the late forties when it jumped to about the 30 million bushel mark. During the last few years it has tended to decline. Relative to national production, wheat increased during the thirties and late forties and declined in the fifties. Currently Michigan produces about 4 percent of the winter wheat crop as compared to about 2.5 percent in the early thirties and forties.

Soybeans: Soybean production has increased rapidly both within the state and nationally. Michigan production has gone from about 63

thousand bushels in 1934 to approximately 5 million bushels in 1957. Michigan produced about 1.2 percent of the soybeans in 1939-41, dropped to about .7 percent in 1949-51 and increased to 1 percent for 1955-57.

Sugar Beets: Michigan sugar beet production reached a peak in the years 1932-33 at about 1.2 million tons. In 1939-41 production was at an average rate of 1.0 million tons annually. By 1949-51 this had dropped to .8 million tons and was still at about the same level in 1955-57. As a percent of national production Michigan is declining in importance. During the peak production years the state contributed about 12 percent of total production. This declined to about 7 percent in 1949-51. Currently it averages about 6 percent.

Potatoes: Michigan potato production has followed a pattern quite similar to that for sugar beets. In 1934 Michigan production was at a peak and totalled 9 percent of total production. By 1939-41 this had dropped to 5.4 percent, to 3.6 percent in 1949-51, and currently averages about 3 percent.

Fruits and Vegetables

Apples: Michigan apple production has tended to increase since 1929. At the same time total apple production has been steady to a slight downward trend. This has meant that Michigan production relative to the rest of the nation has increased through time. In the period 1929-31 the state produced 4 percent of the apples. This increased to 6.8 percent in 1939-41, to 7.9 percent in 1949-51, and for the period 1955-57, averaged about 9.4 percent. Specialization has increased in the state of Michigan while some commercial apple growing areas have declined in importance. The South Atlantic states centering in Maryland and Virginia, the South Central states of Tennessee and Arkansas, and all the Western states except Washington and California show production declines for the average of the years 1946-55 as compared to 1936-45. Michigan during these same periods shows an increase.

Cherries: Sour cherry production in Michigan rose rapidly during the forties from 45 percent of total production in the 1939-41 period to 59 percent in 1949-51 and 54 percent in the 1955-57 period. About four-fifths of the total increase in sour cherry production since 1939-41 has occurred in Michigan.

Peaches: Michigan production of peaches as a percentage of total production had an upward trend until 1950. The severe freeze of 1951 dropped the state's percent of the total from 9.6 percent in 1950 to 1.0 percent in 1951. During the 1955-57 period production had recovered to reach 4.1 percent of the total. This compares with 2.4 percent for 1929-31, 5.0 percent for 1939-41 and 5.1 percent for 1949-51.

Truck Crops: Comparisons of vegetable crops in Michigan relative to the United States in total are difficult because of the heterogeneity of products between areas. About 28 vegetables are included for the national totals and about 17 for the state of Michigan: Both fresh and processed vegetables are included in the estimates. In the 1939-41 period Michigan had about 3 percent of the total acreage devoted to vegetable production in the United States. In terms of production both the state and the nation increased production since 1942 when data became comparable. In 1942-43 Michigan had about 3 percent of total production. This continued to hold at 3 percent for the 1949-51 and 1955-57 periods.

Implications of the Changing Relative Position of Michigan's Agriculture

In terms of cash receipts for all farm products Michigan's agriculture has almost maintained its position relative to the nation for the past thirty years. Table 3 includes such data for the four periods discussed in the previous text.

There are several crops grown in Michigan for which production has increased during the past decades which are not included in this analysis. This makes the following analysis incomplete if total agri-

TABLE 3—Total cash receipts from crops and livestock

Period	United States	Michigan	Michigan as a percentage of U. S.
	Mil. dollars	Thous. dollars	Percent
1929-31	8,916	222,062	2.5
1939-41	9,122	248,528	2.73
1949-51	29,733	678,829	2.23
1955-57	29,978	674,606	2.23

Source: Farm Income Situations and Michigan Agricultural Statistics, June 1957.

cultural production is considered. However, for many of the 19 commodities covered there have been both relative and absolute production decreases.

Table 4 separates the commodities into three groups. Group I indicates those products for which Michigan production averaged for the period (1955-57)[3], declined absolutely with respect to both periods (1939-41) and (1949-51). Group II includes those products whose production increased absolutely in (1955-57)[2] over both periods, and group III includes those products where production has varied between increases and decreases. Table 5 represents the same analysis based on relative levels rather than absolute levels. Group III indicates in some manner those products for which no definite trend has been established.

The implications of changing production patterns in Michigan are complicated and not easily resolved. This paper shall do no more than raise questions regarding them.

It may not be in the best interests of the people of Michigan or the

[3]1955-56 in the case of livestock and livestock products.

TABLE 4—Michigan's absolute production in 1955-57(a) compared to 1939-41 and 1949-51

Products for which absolute production decreased over both previous periods		
Group I	Hogs Wool Chickens	Potatoes Peaches
Products for which absolute production increased over both previous periods		
Group II	Milk Cattle and Calves Broilers Eggs Turkeys	Corn Soybeans Apples Truck Crops
Products for which absolute production varied between increases and decreases		
Group III	Sheep and Lambs Wheat Oats	Sugar Beets Cherries

(a) 1955-56 in the case of livestock and livestock products.

TABLE 5—Michigan's relative production in 1955-57(a) compared to 1939-41 and 1949-51

Products for which relative production declined		
Group I	Milk	Turkeys
	Beef Cattle and Calves	Oats
	Hogs	Sugar Beets
	Sheep and Lambs	Potatoes
	Wool	Peaches
Products for which relative production increased		
Group II	Corn	
	Apples	
Products for which relative production varied between increases and decreases		
Group III	Broiler	Soybeans
	Eggs	Cherries
	Chickens	Vegetables
	Winter Wheat	

(a) 1955-56 for livestock and livestock products.

United States to attempt production increases in the state for all products at a rate comparable with the rest of the nation. Given the current status of the production certain areas have potential production advantages over Michigan which place them in a relatively more favorable position to produce specific products. On the other hand comparative advantages are not static. Research results in developing new techniques can result in man-made advantages in one region overcoming the so-called natural advantages of another. Irrigation, crop varieties, and livestock strains adapted to local conditions, disease and insect control, local market developments, improved transportation services, and better management practices are all methods of improving an area's production advantages. Institutional restrictions imposed involuntarily upon farmers also shift comparative advantages. Price incentives and production control programs are good examples. In addition, the advent of vertical integration with better management services, a decrease in producer uncertainty, and improved credit facilities also shift production to new areas.

The absolute and relative declines in the production of several products in Michigan may have been related to some or all of the following reasons:

1. **Increased Industrialization and Urbanization**

High industrial wage rates and the availability of industrial employment made it expensive to expand production of those enterprises which required an intensive use of labor. The substitution of machinery for labor was encouraged. As a consequence, there has been a trend towards more crop production relative to livestock production, especially where producers combined farming with a nonfarm job.

2. **Limitations of Natural Resources**

Soil, rainfall, temperature and topography have done a great deal toward guiding and limiting production patterns. In some respects such limitations have been reduced by the development of crops and livestock adapted to local conditions or by irrigation. Such resource limitations are important in Michigan under known production techniques and in all probability will be changed only slowly in the future.

3. **Institutional Restrictions**

Included in this category are government control programs, as in the case of corn where acreage increases in many areas of Michigan were not restricted because the counties were not designated as "commercial." The advent of contract feeding in broilers and hogs has also shifted regional production. It brought technology and financial resources to areas which had been lacking previously in these respects and raised their comparative advantage.

The distance from consuming and supplying markets also affected regional production patterns. Adequate feed grain supplies to support a livestock industry and sufficient population to consume the products locally help to determine production patterns. However, improved transportation facilities have tended to decrease the importance of these factors.

4. **Limitations on Knowledge**

Producers desire up-to-date information on production techniques in order to maintain their competitive position. The discovery, through research, of methods to increase regional production advantages, and the dissemination of such information are important factors and should be carried on constantly.

The above implications of regional specialization are not simple in nature. There are interrelationships among all of them which could only be adequately considered in a discussion much more comprehensive than the current one. This article does, however, point out some facts on absolute and relative production trends within Michigan agriculture and suggests some of the reasons why such trends have occurred.

MICHIGAN BROILER TEST NO. 7

FALL 1957[1]

By J. A. DAVIDSON, W. N. FISCHER, and H. C. ZINDEL
DEPARTMENT OF POULTRY HUSBANDRY AND W. K. KELLOGG FARM

PURPOSE OF TEST

THIS WAS A DESCRIPTIVE TEST of varieties, strains, and strain crosses under environment and management conditions at the W. K. Kellogg Farm, Hickory Corners, Michigan.

CONDITIONS OF TEST

The test was conducted on the ground floor of the two-story brooder house on the W. K. Kellogg Farm. Chicks were entered on October 10, 1957. One hundred and four chicks (52 pullets and 52 cockerels) were required for an entry (Table 1). Each entry was placed in a pen of equal floor space, (about 1 square foot per bird) which had been drawn by lot. (In an experiment conducted in 1957, using the same stock in all pens on the same feed, there was no pen position effect at 6 weeks of age.) Each chick was wing-banded for identification as well as a means of simplifying the withdrawal of a sample from which slaughtering data could be drawn.

If not debeaked when sent in, chicks were debeaked; they were then confined to a small area by a tight corral for 2 days. Heat was supplied by heat lamps which were discontinued as soon as possible during the day. Lights were used at night throughout the entire period.

Chicks were fed from a small feeder placed on paper. The paper was removed the second day. Large feeders were substituted for smaller feeders as the chicks grew. All feeders were of the same type for each pen. Small water fountains were used at first until the chicks

[1]Sponsored by the Michigan Poultry and Hatchery Federation, East Lansing, Michigan.

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TABLE 1—Entrants and breeding groups

Entry number	Breeder	Male	Female
1	Hubbard Farms..... Walpole, N. H.	Hubbard 978.....	Hubbard 43
2	Knox County Feed and Hatchery. Vincennes, Ind.	Knox Cornish.....	Knox White Rock
4	DeWitt Zeeland Hatchery..... Zeeland, Mich.	X-236 Experimental	
5	Cleveland Hatchery..... Dana, Ind.	Peterson Cornish.....	Cleveland Hchy. White Rock
6	Cobb's Pedigree Chicks..... Concord, Mass.	W. R. Strain Cross....	White Rock
7	Farm Service Center, Inc..... Orleans, Ind.	Vantress.....	Arbor Acres
8	DeWitt Zeeland Hatchery..... Zeeland, Mich.	Special Experimental	
9	Farm Service Center, Inc..... Orleans, Ind.	Peterson Cornish.....	Arbor Acres
10(*a*)	Weaver's Hatchery, Inc..... Wakarusa, Ind.	Vantress.....	Arbor Acres
11	DeWitt Zeeland Hatchery..... Zeeland, Mich.	X-235 Experimental	
12	Lambright Hatchery..... LaGrange, Ind.	Vantress.....	White Cornish

(*a*) Chicks were 4 days younger than the other entries.

were large enough to use automatic waterers. Sugar-cane litter was used and some shavings were used the last few weeks.

Disease Control

A coccidiostat (Nicarbazin) was used in the feed throughout the first 7 weeks of the test. At 10 days the chicks were vaccinated by the water method against Newcastle disease. Reaction to vaccination did not seem to be severe in any of the groups.

Weighing and Scoring

At 4 and 8 weeks, each entry was group-weighed and the following information was obtained for the benefit of the breeder or hatchery: average live weight, feed consumed, and number in each pen. All pens were reduced to 100 birds at 4 weeks.

At 10 weeks of age, the birds were individually weighed, checked for sex, and a random sample of 10 of each sex was taken for slaugh-

TABLE 2—Feed conversion and mortality—10 weeks

Entry number	Percent mortality	Pounds of chicken per 100 lbs. feed	Feed per pound of chicken	Number	
				Males	Females
1	1.00	37.17	2.69	50	49
2	....	37.22	2.69	49	51
4	1.00	37.84	2.64	47	52
5	....	38.63	2.59	52	48
6	2.00	39.66	2.52	49	49
7	2.00	37.79	2.65	50	48
8	1.00	38.58	2.59	49	50
9	....	38.35	2.61	47	53
10(*a*)	1.00	38.99	2.56	46	53
11	....	38.35	2.61	50	50
12	1.00	38.32	2.61	46	53
Total or average	.82	38.25	2.62	535	556

(*a*) Chicks were 4 days younger than the other entries.

tering (Table 2). The mean weight of the males and females along with the variability in each group is shown in Table 3.

A comparison of the 8- and 10-week mean weight of the entries (Table 4) indicates that under our conditions the majority of the entries

TABLE 3—Live weight and variability of each sex—10 weeks

Entry number	Males		Females	
	Av. wt.	Variability	Av. wt.	Variability
	(lb.)		(lb.)	
1	4.35	9.37	3.51	7.47
2	4.35	11.32	3.42	8.91
4	4.06	7.92	3.26	9.35
5	4.20	7.95	3.37	7.38
6	4.66	10.86	3.57	7.52
7	4.29	11.59	3.49	6.16
8	4.33	9.28	3.47	8.36
9	4.32	8.05	3.37	7.17
10(*a*)	4.02	10.61	3.23	9.36
11	4.02	8.29	3.14	9.32
12	3.80	11.77	3.18	9.37
Average	4.20	.....	3.36	....

(*a*) Chicks were 4 days younger than other entries.

TABLE 4—Comparison of 8- and 10-week weights and feed utilization

Entry number	Mean weight of birds (lb.)		Feed per lb. of chicken	
	8 weeks	10 weeks	8 weeks	10 weeks
1	3.05	3.94	2.52	2.69
2	2.99	3.86	2.42	2.69
4	2.76	3.64	2.35	2.64
5	2.88	3.80	2.34	2.59
6	3.14	4.11	2.25	2.52
7	2.91	3.90	2.39	2.65
8	2.90	3.89	2.39	2.59
9	2.88	3.82	2.38	2.61
10(*a*)	2.60	3.60	2.30	2.56
11	2.59	3.58	2.39	2.61
12	2.55	3.47	2.42	2.61
Average	2.84	3.78	2.38	2.62

(*a*) Chicks were 4 days younger than the other entries.

would not classify as heavy broilers (3 to 4 pounds). However, a considerable number of individual birds would fall in this classification since the over-all average weight was 2.84 pounds at 8 weeks.

The samples were mixed in pens where they remained overnight. They were loaded the next morning—20 in a crate—and transported to the Hamilton Farm Bureau, Hamilton, Michigan. There, live weights were taken as they were hung on the dressing line. The eviscerated weights were recorded and the birds scored for quality (Tables 5 and 6). The market grade was based on the sample using a 1 to 5 point scale.

Feed

The chicks were fed a commercial broiler-starter until they were 7 weeks old. A broiler-finisher was used for the balance of the test.[2] The guaranteed analysis of the starter was crude protein, minimum 24 percent; crude fat, minimum 5.5 percent; and crude fiber, maximum 2.75 percent. The finisher was guaranteed to contain 21 percent protein, 5.5 percent fat, and not over 2.75 percent fiber.

[2]The feed for this test was manufactured by the Harris Milling Co., Mount Pleasant, Mich.

TABLE 5—Live and eviscerated weights of samples and carcass yields—10 weeks

Entry number	Average weights				Carcass yields	
	Live		Drawn			
	Male	Female	Male	Female	Male	Female
	(lb.)	(lb.)	(lb.)	(lb.)	(percent)	(percent)
1.....	4.44	3.54	3.43	2.77	77.25	78.24
2.....	4.35	3.44	3.38	2.70	77.70	78.48
4.....	4.05	3.41	3.13	2.60	77.28	76.24
5.....	3.90	3.39	3.20	2.65	82.05	78.17
6.....	4.70	3.63	3.62	2.85	77.02	78.51
7.....	4.47	3.42	3.50	2.73	78.29	79.82
8.....	4.18	3.42	3.25	2.70	77.75	78.95
9.....	4.30	3.45	3.35	2.69	77.91	77.97
10(*a*).....	3.90	3.17	2.97	2.43	76.15	76.65
11.....	3.91	3.31	2.99	2.57	76.47	77.64
12.....	3.73	3.10	2.96	2.43	79.35	78.39
Average...	4.10	3.39	3.25	2.65	77.93	78.11

(*a*) Chicks were hatched 4 days later than other entrants.

TABLE 6—Dressed score of samples—10 weeks(a)

Entry number	Carcass grade(*b*)										Percent grade A
	Fleshing		Feathering		Fat		Conformation		Defects-(*c*)		
	M	F	M	F	M	F	M	F	M	F	
1.....	1.60	1.54	1.05	1.18	1.38	1.22	1.38	1.22	1.44	1.04	75
2.....	1.30	1.35	1.10	1.00	1.15	1.05	1.15	1.15	1.40	1.10	80
4.....	1.35	1.60	1.15	1.10	1.30	1.25	1.20	1.10	1.20	1.10	85
5.....	1.45	1.60	1.05	1.10	1.15	1.10	1.20	1.15	1.15	1.05	80
6.....	1.30	1.40	1.00	1.05	1.20	1.15	1.05	1.25	1.35	1.10	80
7.....	1.25	1.45	1.00	1.05	1.30	1.40	1.10	1.05	1.30	1.00	75
8.....	1.40	1.35	1.05	1.05	1.35	1.25	1.00	1.15	1.10	1.00	100
9.....	1.25	1.55	1.10	1.10	1.25	1.20	1.05	1.05	1.20	1.05	80
10(*d*)....	1.60	1.65	1.10	1.10	1.50	1.30	1.10	1.10	1.15	1.05	75
11.....	1.45	1.50	1.10	1.05	1.40	1.20	1.05	1.10	1.00	1.00	85
12.....	1.40	1.70	1.05	1.05	1.30	1.40	1.25	1.05	1.10	1.10	60
Av..	1.39	1.52	1.07	1.08	1.30	1.23	1.14	1.12	1.21	1.05	..

(*a*) The authors wish to express appreciation to Dr. L. E. Dawson and his graduate students for scoring and grading the dressed birds.
(*b*) Dressed score: 1, 2, 3, 4, 5. Based on federal standards of quality—average score shown.
(*c*) Defects: Includes breast blisters, crooked and dented breast bones, crooked backs, etc.
(*d*) Chicks were hatched 4 days later than other entrants.

Limitations

Results from such samples should not be interpreted competitively by entrants.

Relatively little reliance should be placed on information from only one test. Repeated testing will be required to reliably evaluate real performance of strains and strain crosses. It is hoped this attitude will be expressed by the entrants in using these data for other than their own information. A winner cannot be picked because of the problem of fairly evaluating the various characteristics which were observed.

A DETACHABLE LUG CARRIER FOR HARVESTING RASPBERRIES TO BE PROCESSED[1]

By H. P. GASTON[2], J. H. LEVIN[3], and SCOTT HEDDEN[3]

MICHIGAN, NEW YORK, AND OREGON together grow more than 50 million pounds of raspberries. In these areas the growing of raspberries is big business. The fruit is also of commercial importance in several other states. It is estimated that well over half of the red varieties and more than 95 percent of the blacks are processed. Although some growers sell on the fresh fruit market as well as to processors, all of the fruit produced by many commercial growers is either canned or frozen.

The raspberry (particularly the red varieties) is one of our most tender fruits. It must be handled with care if its quality is to be maintained until it reaches the consumer's table or the processing plant. The harvesting and handling operations are time consuming and costly. When conventional methods are employed, the berries are usually poured from picking containers into lugs. This step in the operation sometimes causes considerable mechanical injury.

The use of the recently developed "ventilated picking lug"[4] enables strawberry growers, who sell to processors, to increase the efficiency with which their crop can be handled.

During the 1957 harvest season a study was made in which a similar container was used in harvesting raspberries. Michigan State University, the U. S. Department of Agriculture, Michigan Fruit Canners, Inc., and Duane Carter, Coloma, Michigan, cooperated in these tests. The purpose of this work was to determine whether an adaptation of

[1]The writers wish to express their appreciation to Duane Carter, Coloma, Mich., on whose farm the trials were conducted. Credit is also due Michigan Fruit Canners, Inc., Benton Harbor, Mich., who helped to collect the data, made the quality control studies, processed the fruit, and helped in other ways.

[2]Department of Horticulture, Mich. State Univ.
[3]Agricultural engineer, Agricultural Engineering Research Division, A.R.S., U.S.D.A.

[4]Gaston, H. P., and J. H. Levin (May, 1957). Ventilated picking lugs for strawberries. Mich. Agr. Expt. Sta. Quart. Bul. 39-54:12.

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the V-lug method developed for strawberries could be used to advantage in handling raspberries.

A detachable stand and lug carrier was designed. A dozen of these units were used in a Michigan commercial raspberry harvesting operation. Time, cost, and quality studies were made. These included in-the-field studies of the harvest operation and at-the-plant checks on quality. Some of these were made before processing. Other lots were canned and held for several months, at which time the cans were opened and the quality checks made.

THE DETACHABLE LUG CARRIER AND STAND

The detachable lug carrier is a metal frame made from ¼-inch iron rod. It is designed so that a conventional berry lug can be readily slipped in or out of the unit. The carrier holds the lug 10 inches off the ground and provides a means of carrying it. (Figs. 1 and 2).

In the conventional method of harvesting raspberries that are to be processed, each picker receives a carrier containing a number of pint or quart boxes. When these have been filled, the picker takes the car-

Fig. 1. A berry lug is slipped into a "lug carrier."

Fig. 2. The lug carrier makes it easy for the picker to carry the lug into the field.

rier to a check-in station where the fruit contained in the small boxes is poured into a lug. This lug is later moved to the processing plant. The picker is credited with the fruit he has checked in. The empty pint (or quart) boxes are replaced in the carrier, and the unit returned to the picker.

When the "lug carrier method" is used, one of these units, containing a lug, is issued to each picker. The worker places the fruit in the lug as it is picked (Fig. 3). When the unit has been filled, it is carried to the check-in station where the filled lug is slipped out and replaced with an empty one.

ADVANTAGES OF THE LUG CARRIER METHOD

Equipment Costs are Less. In the conventional method the grower must provide carriers and pint or quart boxes. A good carrier costs $1.00 or more. The boxes which go into it cost approximately 1 or 2

cents each, depending on whether they are pints or quarts. The boxes usually have to be replaced at least once during the season.

When the lug carrier method is used, the grower provides only the stand, which usually can be made up for $1.00 or less.

Picking is Easier. Since the stand holds the lug up off the ground, the unit makes it unnecessary for the picker to stoop as low as when carriers (which rest on the ground) are used (Fig. 3).

Helps Keep the Fruit Clean. When carriers that rest on the ground are used, a considerable amount of dirt tends to work into the boxes containing the fruit. This is particularly true when pickers push the carriers along with their feet as some of them do. The stand which holds the lug up off the ground eliminates this difficulty.

Fig. 3. The lug carrier holds the lug 10 inches off the ground and makes it unnecessary for the picker to stoop as low as he does when conventional carriers which rest on the ground are used.

Reduces Handling. When the conventional method is used, the berries are poured over at the check-in station. This handling tends to bruise the tender berries. When the lug carrier method is used, the at-the-shed pouring operation is eliminated (Fig. 4). This makes it possible to reduce the amount of help ordinarily required at the check-in station. Time studies show that it requires about three times as long to check in a given amount of fruit brought up in carriers as it does to record the same amount in lugs.

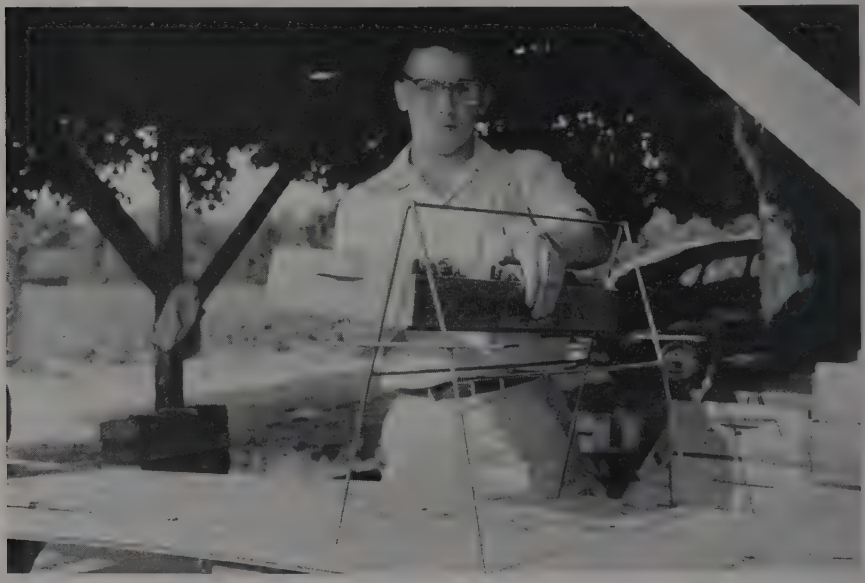

Fig. 4. It is easy for the checker to remove the filled box from the lug carrier. The lug is transported to the processing plant without pouring over the fruit which it contains.

LIMITATIONS

Berries that are destined for the fresh fruit market are usually picked in pint boxes. Growers who sell a part of their crop as fresh fruit with the remaining fruit going to processors, may find it difficult to change from the lug carrier method to the conventional method or vice versa, if it is necessary to do so frequently.

A carrier containing 10 filled pints weighs approximately 11½ pounds (7½ pounds of fruit). A filled lug and stand weigh approximately 18½ pounds (13½ pounds of fruit). The fact that the filled lug and stand weigh more than a filled carrier makes it difficult for small

children to carry them to the check-in station. This is considered a disadvantage by some pickers. Others, however, like the lug because it holds more fruit and reduces the number of times that a picker must go to the check-in station.

Some of the pickers who used the lug-carrier method during the trials said that in their opinion it was difficult to estimate with accuracy the amount of fruit checked in and that they might not always receive credit for the full amount. In order to eliminate this source of dissatisfaction, the cooperating grower provided scales on which the lugs were weighed. Payments were made on the basis of weight. Weighing the fruit took a little more time, but it eliminated the chance for error.

CONCLUSIONS

The trials indicated that raspberry growers who produce fruit exclusively for the processing market may find it advantageous to use the lug carrier method. Growers who would like to try this system can obtain working drawings of the necessary stands by addressing a request to the Agricultural Engineering Department, Michigan State University, East Lansing, Michigan.

GRADE DEFECTS OF CONTROLLED-ATMOSPHERE APPLES AND THEIR EFFECT ON STORAGE RETURNS

By D. H. DEWEY[1]

DEPARTMENT OF HORTICULTURE

PREMIUM PRICES ARE USUALLY obtained for apples stored in controlled atmospheres (C-A), provided they are of high quality. However, defective apples from these storages are difficult to sell because the normal outlets for cull apples (such as itinerant truckers and cider processors), are relatively unavailable during the months of April, May, and June when C-A apples are normally marketed. This means there is little or no opportunity to recover their handling and storage expenses as is often possible for defective fruit from regular storage. Even if it were possible to merchandise the off-grade apples, it is doubtful the returns would cover the costs, since C-A storage is more expensive than regular storage. Furthermore, the amount of C-A storage space is limited, and the demand for high quality C-A apples exceeds the present supply.

Examination of the fruit removed from Michigan C-A storages in the spring of 1958 indicated that considerable storage space was wasted on inferior quality apples. A study was therefore made to determine the extent and cause of the defects responsible for the off-grade fruit and the relation of quality to the possible net returns.

DEFECTS FOUND ON STORED APPLES

Orchard-run apples in field crates of approximately one bushel capacity were removed at random from three grower-operated storages in Michigan on March 26 and 27. Each apple was carefully inspected and graded according to U.S. standards. The substandard apples were classified by the causal factor responsible for their failure to meet U.S.

[1]The assistance of Gerhard Bünemann and W. G. Chace, Jr. in obtaining the data of this study is gratefully acknowledged.

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No. 1 requirements. Representative inspection results for the 33 crates of McIntosh from 11 orchards and the 22 crates of Jonathan apples from 5 orchards are presented in Table 1. The total percentage of fruit of the various classifications in most instances exceeds 100 percent since some apples had more than one defect, and each was included in the several appropriate classifications. The defects are grouped according to the place or time of occurrence, namely, during the growing season, during harvesting and handling, and during storage.

Some of the defects classified as storage-induced were undoubtedly favored by damage that occurred during either growing or harvesting and handling. For example, excessive quantities of decay developed in conjunction with large amounts of mechanical injuries in lots 4, 5, and 10 of McIntosh. Shriveling was high for McIntosh lot 6 where an absence of adequate red coloration indicated a lack of proper maturity at harvest. For Jonathan lots 15 and 16, excessive russeting was a likely cause of shrivel during storage.

Defects developing during storage other than those associated with earlier damage such as russeting, immaturity, or mechanical injuries, were generally of minor quantity (Table 1). C-A injury, due either to low oxygen or high carbon dioxide, affected 2 to 4 percent of the fruit in 5 of the 33 lots of McIntosh examined. Nine lots had less than 2 percent injury and 19 crates were free of C-A injury. Storage scald and internal breakdown, frequent occurring disorders of McIntosh in long-time regular cold storage, were minor.

Storage defects of Jonathan were primarily shrivel and decay. Jonathan spot was observed in two lots, and probably was present prior to storage since C-A storage prevents its development (Dewey, et al. 1957). Internal breakdown and soft scald, which often occur in regular storage, were absent. Also, injury due to either excessively low oxygen or high carbon dioxide in the storage atmosphere was not observed on Jonathan.

Defects originating during growth and development were present in relatively large quantities in many lots of fruit. Some, such as abnormal fruit shape, hail marks, and many of the russet injuries, are unavoidable since they are caused by unfavorable weather conditions. Most other orchard defects can be avoided by good management and operational practices. Only three lots of McIntosh and one lot of Jonathan had less than 5 percent of the fruit with defects initiated during the growing season.

TABLE 1—The percentage of unmarketable apples in representative lots of fruit removed from C-A storages in 1958

Variety	McIntosh										Jonathan						
Lot number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Defects caused by preharvest conditions																	
Small size <2¼"	0.0	0.0	1.5	3.4	1.4	0.0	0.0	0.0	0.9	0.9	4.0	1.3	4.4	1.6	0.0	0.6	0.0
Red color <25%	0.0	3.6	26.7	0.0	13.5	13.8	0.0	0.0	0.0	0.9	0.0	0.0	1.3	0.0	0.0	0.0	0.6
Misshapen.....	3.3	2.7	2.3	1.4	0.0	0.9	0.0	0.0	0.9	0.9	0.0	0.0	0.6	0.8	0.0	0.0	0.0
Limb rub.....	0.0	0.0	1.5	0.0	4.3	0.9	0.0	1.1	0.9	2.7	1.3	2.6	0.6	0.0	0.0	0.6	1.3
Insect stings...	2.5	0.9	5.3	4.1	4.3	2.6	0.0	1.1	1.8	0.0	1.3	3.2	1.3	3.2	0.6	1.2	2.5
Insect larvae...	0.0	1.8	0.0	0.7	2.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	4.7	0.6	0.0	0.0
Scab.....	0.0	0.0	3.1	2.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hail.....	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.6	21.2	1.3	0.0	3.9	0.0	0.0
Russet.....	7.4	6.3	3.1	4.8	2.1	0.0	2.4	1.1	3.6	0.0	0.7	2.6	0.6	2.4	10.7	17.2	1.9
Miscellaneous..	0.0	0.9	1.5	0.0	0.0	0.0	1.6	0.0	0.0	0.9	0.0	0.0	0.0	0.8	0.0	0.0	0.0
Total.....	13.2	16.2	45.0	16.4	29.1	18.2	4.0	3.3	8.1	6.3	64.9	32.2	11.4	13.5	15.8	19.6	6.3
Mechanical injury during harvesting and handling																	
Bruises.....	10.7	44.1	28.2	82.3	32.6	3.5	1.6	6.4	10.9	62.5	7.3	0.0	7.5	3.2	0.0	12.1	26.9
Skin breaks....	0.8	3.6	0.8	0.7	4.3	4.3	0.8	3.2	8.2	3.6	0.7	0.6	0.0	0.0	3.2	6.3	1.9
Total.....	11.5	47.7	29.0	83.0	36.9	7.8	2.4	9.6	19.1	66.1	8.0	0.6	7.5	3.2	3.2	18.4	28.8
Defects developing in storage																	
Decay.....	0.0	2.7	1.5	6.1	8.5	0.9	0.8	0.0	3.6	26.8	0.7	1.3	0.0	1.6	0.6	0.0	0.6
Scald(*a*).....	0.0	0.0	0.8	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C-A injury.....	0.0	0.9	1.5	0.0	0.0	0.0	1.6	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shrivel.....	0.0	0.0	0.0	0.0	0.0	13.8	0.0	1.1	0.9	0.0	1.3	0.0	0.0	0.0	3.9	7.5	0.6
Total.....	0.0	3.6	3.8	6.1	9.2	14.7	2.4	1.1	4.5	30.4	2.0	1.3	0.0	1.6	4.5	7.5	1.2
SOUND FRUIT.....	81.0	45.1	44.3	13.6	40.4	88.8	91.2	91.5	71.8	13.4	33.1	69.9	82.4	85.0	78.9	72.4	66.3

(*a*) Storage scald on McIntosh; soft scald on Jonathan.

Careful harvesting and handling methods kept damage during these operations as low as 2.4 percent for McIntosh and .6 percent for Jonathan. The maximum amounts of damaged fruit, 83 and 28.8 percent for McIntosh and Jonathan, respectively, obviously were due to extremely careless picking, dumping, and carting practices. More than one-half of the McIntosh lots examined contained less than 20 percent damaged fruit. It is suggested that this should be the maximum quantity permitted for average conditions of harvesting and handling. Good operations should cause no more than 10 percent damage on McIntosh and 5 percent on Jonathan.

The average percentages of defects according to their place or time of origin are shown in Table 2. Defects originating during growth and development of the fruit affected approximately one-fourth of the apples of both varieties. With McIntosh, another one-fourth of the apples were damaged during the harvesting and handling operations from tree to storage. This damage was considerably less for Jonathan, which is a firmer-fleshed variety more resistant to damage by rough handling. Defects developing during storage were of relatively small quantity in comparison to the other defects observed in these lots.

TABLE 2—Origin and average quantity of defects of apples from C-A storages

Place or time of occurrence of defect	Variety		All lots
	McIntosh	Jonathan	
	(Percent)	(Percent)	(Percent)
Orchard	23.6	26.4	24.7
Harvesting and Handling	26.1	9.5	19.5
Storage	6.4	2.4	4.8
Sound apples	55.5	67.2	60.2

Note: The figures in each column total more than 100 percent since some apples had more than one defect and were included in the several appropriate classifications.

STORAGE AND PICKING COSTS

Many of the costs associated with harvesting, handling, and storing fruit are inflexible since they are determined primarily by labor and overhead charges. Since Michigan apples are usually stored orchard-run in crates, the handling and storage costs are normally determined

on the basis of the crate units with no consideration of quality. These costs per unit of packed fruit of marketable quality are determined by the yield of suitable fruit from the storage crates. A high pack-out rate means a minimum cost per unit of No. 1 or higher grade fruit. A low pack-out rate will increase the cost per unit of marketable fruit.

Costs considered in this study include the labor and overhead expense of sorting the apples from the field crates and the costs of C-A storage operation. The relationship of these costs for U.S. No. 1 apples to the quantity of off-grade fruit stored and sorted is shown in Table 3. Assuming that one field crate holds 42 pounds of fruit, a crate containing 95 percent of U.S. No. 1 or better fruit will yield approximately 40 pounds of marketable apples or one unit of C-A fruit as normally merchandized as a cell pack, tray pack, or carton of fruit in polyethylene bags.

A packing and sorting cost of 15 cents for each field crate of stored apples is used here to illustrate the effect of culls on packing costs. Costs of jumble packing fruit in Michigan range from 11.3 to 20.2 cents per bushel of packed fruit according to Gaston and Levin (1957). Dalrymple (1956) gives an average cost of 28 cents per packed cell carton of C-A McIntosh, including utility grades, in New York State for hand sorting and packing. An earlier study in Vermont (Metz, 1954) showed the total cost for grading and packing ranged from 16 to 31 cents per packed box.

TABLE 3—Storage and sorting costs of U.S. No. 1 C-A apples as affected by off-grade fruit

Sound fruit per field crate	Field crates to yield 40 lb. U.S. No. 1 or better fruit	Cost per 40 pounds of U.S. No. 1 or better fruit		
		Sorting and packing(*a*)	C-A storage(*b*)	Total
(Percent)	(Number)	(Dollars)	(Dollars)	(Dollars)
95.....	1.0	.15	.50	.65
85.....	1.1	.17	.55	.72
75.....	1.3	.20	.65	.85
65.....	1.5	.23	.75	.98
55.....	1.7	.26	.85	1.11
45.....	2.1	.32	1.05	1.37
35.....	2.7	.41	1.35	1.76
25.....	3.8	.57	1.90	2.47
15.....	6.3	.95	3.15	4.10

(*a*) Estimated at $.15 per field crate sorted.
(*b*) Estimated at $.50 per field crate stored.

A minimum C-A storage cost is estimated at 50 cents per crate (Dalrymple, 1956). This is about double the cost of regular refrigerated storage in Michigan (Gaston and Levin, 1954) and is due to the longer storage period, the additional equipment, supplies, and facilities needed, and the greater labor requirement for supervision and operation.

Applying these costs to orchard-run lots containing 95 percent sound fruit would mean a C-A storage and sorting expense of 65 cents for each 40 pounds of U.S. No. 1 or higher grade apples. The increase in these costs for each 40 pounds of marketable fruit as a result of storing apples containing 25 percent culls, amounts to 20 cents, bringing the total cost to 85 cents per 40 pounds of U.S. No. 1 apples packed. The data of Table 2 show that defects occurring in the orchard caused an average of 25 percent culls so thereby added 20 cents to the cost of each 40 pounds of U.S. No. 1 fruit prepared for market. Had all McIntosh been sound on the tree, the 25 percent of the fruit damaged by rough handling during harvest and movement into storage would cost at least 20 cents.

C-A storage and sortings costs per packed bushel are double when approximately one-half of the stored fruit is below U.S. No. 1 standards. This was true for 16 of the 33 lots of McIntosh and 4 of the 22 crates of Jonathan examined.

An additional profit of at least 50 cents per crate is usually anticipated for apples from C-A over the normal profit obtainable from apples in regular storage. This is low according to the experience of C-A operators in Michigan for 2 years, but seems reasonable according to the estimates of Dalrymple (1956) that growers using C-A storage in the Hudson Valley area of New York received a premium of at least 43 cents per container of merchandized apples for the period 1944 to 1951.

This anticipated premium in profit is practically eliminated by the increased costs shown in Table 3 when 45 percent of the stored apples are culls. Also, the potential value of the C-A storage space for yielding a profit must be considered. With 95 percent sound fruit occupying the storage space the full profit potential can be realized; whereas, if 25 percent of the apples are below grade, the potential profit is proportionally decreased. Fifty-five percent culls will automatically cut the potential profit by more than one-half since 2.1 stored crates of apples will yield only one bushel of marketable fruit.

RECOMMENDATIONS

The profits expected because of the premium prices normally obtained for C-A fruit can be readily canceled when apples of low quality are stored. Contributing factors are the demand for apples only of high quality, the limited outlets for cull fruit, and the increased storage costs. The limited C-A storage space now available in Michigan, which amounted to approximately 140,000 bushels in the 1957-58 season, can be used to best advantage when filled with fruit relatively free of U.S. No. 1 grade defects.

Excessive quantities of substandard apples were found in the storages examined in this study. Many of the defects responsible for the off-grade fruit originated during the growing and harvesting operations rather than during the storage period. Many growers are unaware of the extent of these defects because the apples are stored orchard-run. The large quantity of fruit that must be handled in a short period of time at harvest often causes negligence to the extent that the grower overlooks the quality and condition of his fruit. Observers may incorrectly associate the defects with the storage method and overlook the true causes of the damage.

Fruit for C-A storage should be carefully selected to meet market requirements. This can be done in some instances by choosing orchards or trees within an orchard. In other cases, a system of sorting as the apples are harvested or prepared for storage would be feasible. Gaston and Levin (1951) have shown that a mobile orchard grader can be effectively used in many Michigan orchards. It seems worthy of trial as a means of improving the quality of C-A apples.

The size of a grower's C-A rooms should depend upon the quantity of high grade fruit he will have available for C-A storage in most years. In the event of a short or damaged crop, a storage operator would have a better opportunity for profit by purchasing high quality fruit to complete the filling of a C-A room, rather than filling it with low quality apples.

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FORCING AND GROWTH OF ORNAMENTAL PLANTS IN CONTAINERS

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THE NURSERY INDUSTRY encounters serious economic and labor handicaps because of the need to employ large labor forces during spring and fall when most nursery stock is sold or transplanted. Research has been primarily limited to the feasibility of growing plants in containers (Barker, 1956; Stoutemyer, 1955 and 1957; and Swoboda, 1941) and to the forced growing of some of the hardy shrubs (Fisher, 1945; and Wyman, 1955). There may be feasible methods of reducing these handicaps to extend the spring and fall planting seasons and to stimulate summer and winter sales of ornamental plants.

CULTURAL TECHNIQUES

Summer Transplanting

To determine the feasibility of transplanting deciduous and evergreen ornamentals during the summer months, *Spiraea bumalda* 'Anthony Waterer,' *Philadelphus virginalis,* and *Syringa vulgaris* (18 to 24 inches tall) were dug July 6 and 7, 1956, and transported to the greenhouse where all adhering soil was carefully washed from the roots. *Spiraea* and *Philadelphus* were pruned 6 to 8 inches to form well-shaped plants. *Syringa* remained unpruned.

The plants were potted in 8-inch plastic pots, using a uniform potting mixture of 2 parts clay loam, 1 part sand, and 1 part peat, to which were added 2 ounces of urea formaldehyde fertilizer (38-0-0) and 2 ounces of double-superphosphate (0-45-0) per bushel of mixture. The plants were then placed in shaded cold frames. Half of the plants received mist for 5 to 12 days following transplanting, depending upon

[1]In partial fulfillment for the degree Master of Science.

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the condition of the plants. In these cases constant mist was applied during the daylight hours using three-gallons of water per hour nozzles.

Forty-eight balled and burlapped plants of Black Hills spruce *(Picea glauca densata)* and Scots pine *(Pinus sylvestris)* were subjected to various transplanting treatments. Soil was carefully washed from the roots and plants were pruned before potting on Aug. 3, 4, and 5. Mist was applied constantly in the daytime during the first week after transplanting, followed by a hardening-off period. During this period mist was applied during the afternoon with the shade being removed after 4 weeks.

Sixteen of the evergreen plants were placed in 8-inch plastic pots after reducing the soil ball. These plants were placed in shaded cold frames. Half of them received mist. All deciduous and evergreen plants which received no mist were sprinkled two or three times daily for the first few weeks following transplanting.

All deciduous shrubs survived summer transplanting. Although considerable leaf drop occurred on some plants, new leaves were soon produced. Mist was beneficial on *Philadelphus* and *Spiraea* but did not improve the rate of recovery of *Syringa*. All evergreen trees transplanted with a ball of soil survived, as compared to 72 percent for bareroot trees. Seventy-eight percent of the trees surviving transplanting with a ball of soil were in excellent condition compared to 47 percent for bareroot trees.

Container Growing

All flowering plants used in transplanting studies were also used for container growing. Eight-inch plastic pots were utilized throughout the project and were satisfactory for growing 18- to 24-inch plants. All plants were overwintered in coldframes without protection. No overwintering, nutritional, disease, or soil mix difficulties were encountered in growing the deciduous and evergreen plants in containers.

Forcing

The deciduous flowering shrubs were forced in a greenhouse regulated at approximately 65° F. (night temperature) for Easter and Mother's Day. The flowering characteristics of these plants are shown in Table 1. *Philadelphus* were excellent plants for forcing and required the least cultural care of the deciduous shrubs. *Spiraea* required more frequent applications of malathion to control insects than any other va-

Fig. 1. Container-grown *Spirea bumalda* in flower. Colorful plastic pots have wide adaptability to sales appeal.

TABLE 1—Flowering results for selected ornamentals grown in a greenhouse at 65° F. (Night temperature)

Plant	Normal date of flowering outdoors	Number of days from March 28 until flowering	Flowering(*a*)
Aquilegia vulgaris 'Giant Mixed'	Late May	37-45	Uneven
Armeria launcheana	Mid-May	16-21	Uneven
Dicentra eximia	Early May	13	Even
Iberis sempervirsens 'Purity'	Early May	23	Even
Penstemon newberryi	Mid-May	24	Even
Philadelphus virginalis	Mid-June	40	Even
Spiraea bumalda 'Anthony Waterer'	July	50-54	Even
Syringa vulgaris	Mid-May	21-25	Uneven
Veronica spicata 'Minuet'	July	56-70	Uneven

(*a*) Based on uniformity of flowering between plants and/or possessing undesirable growth habit.

riety. Few flower buds were initiated on *Syringa* during the previous fall growing season while the plants were recovering from transplanting. Consequently, few flowers resulted.

Selected perennials were forced for Easter and Mother's Day to determine the market potential for such plants. *Dicentra eximia, Iberis sempervirens* 'Purity', and *Penstemon newberryi* produced vigorous plants which flowered uniformly. *Aquilegia vulgaris* 'Giant mixed', *Armeria laucheana,* and *Veronica spicata* 'Minuet' were not as satisfactory for forcing due to uneven flowering or undesirable growth habits.

Marketing

All plants were marketed at a local garden center.[2] In December the evergreen trees were sold as living Christmas trees. They were well accepted, although many customers would have preferred a slightly larger tree than the 18- to 24-inch size offered. *Picea* proved more satisfactory as living Christmas trees than *Pinus* because of their finer leaf texture, more dense form, and greener needle color.

The deciduous flowering shrubs were marketed in bloom at Easter time and prior to Mother's Day. *Philadelphus* were exceptionally popular at Mother's Day as they possessed abundant, fragrant, attractive flowers. *Spiraea* and *Syringa* were also favorably received. In all cases, sales of dormant stock were stimulated by displaying a flowering shrub near similar dormant varieties. In this way, customers were able to compare dormant and flowering shrubs (Fig. 1) directly, which is important since many customers do not recognize shrubs except when in flower. Estimated cost of production and selling price are indicated in Table 2.

Armeria, Aquilegia, and *Dicentra* were marketed with abundant, attractive flowers. *Iberis* had attractive flowers which persisted for 3 continuous weeks but sold slowly as customers preferred to wait a few weeks for normal flowering plants which were sold at a much reduced price. *Penstemon* sales lagged as they possessed a low, spreading growth habit and prospective customers were not familiar with the plant. *Veronica* was not marketed as the time required for flowering exceeded the planned dates of sale. *Armeria* sold at this profit would require a huge volume of sales to be economically feasible.

[2]Richter's Gardens, 4801 South Cedar, Lansing, Michigan.

TABLE 2—Cost of production and selling price of plants

Plant	Total estimated cost of production(a) of forced plants and evergreens	Selling price (retail) (b)	
		Forced plants	Dormant plants
Flowering Plants:			
Aquilegia vulgaris 'Giant Mixed'	$ .50	$1.00	$ .75
Armeria launcheana	.45	.50	.35
Dicentra eximia	.45	1.00	.85
Iberis sempervirens 'Purity'	.45	1.00	.80
Penstemon newberryi	.45	1.00	.90
Philadelphus virginalis	1.25	2.50	1.25
Spiraea bumalda 'Anthony Waterer'	1.25	2.50	1.25
Syringa vulgaris	1.50	2.50	1.50
Veronica spicata 'Minuet'	.60	Not marketed	.90
Evergreen Plants:			
Picea glauca densata	2.75	4.00	4.50
Pinus sylvestris	2.75	4.00	4.00

(a) The total estimated cost of production was for the year 1956-1957 and includes such items as original cost of the plants, labor, pots, spray materials, fertilizers, greenhouse space, and potting soils.
(b) The selling price was calculated according to standard commercial practice.

Summary and Recommendations

Various methods were studied by which the nursery industry could extend the spring and fall planting seasons and stimulate summer and winter sales.

Techniques compared included bareroot transplanting, balling, and misting methods. Highest survival rate occurred when a ball of soil covered the plant roots. Misting increased survival on *Pinus* but had no effect on *Picea*.

Frequent watering and applications of soluble fertilizers are necessary during periods of active growth of container grown plants, because of limited soil in the container. Leaf drop does not seriously affect the survival of deciduous plants after transplanting as new leaves are soon produced. It is necessary to maintain the plant in vigorous growing condition, and control disease and insect pests to produce quality plants.

Potted Christmas trees and flowering deciduous shrubs were favorably received in local markets. For increased sales, larger specimens are recommended for Christmas trees. Dormant stock should be displayed with flowering shrubs of the same species to increase sales.

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THE VALUE OF A SMALL LACTOMETER FOR DETERMINING TOTAL SOLIDS IN HERD MILK[1]

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IN A STUDY OF THE VARIABILITY of quantity and quality of herd milk, two methods for measuring total solids were conducted. The Mojonnier method was used as the standard, while the small lactometer method described by Watson[2] served as a rapid measurement of total solids.

Previous work by Madden and Brunner[3] indicated the reliability of this lactometric method for measuring total solids of individual cows milk. Since herd milk would be expected to be less variable than individual cows milk, and because the dairy processor procures herd milk, this lactometric procedure was studied to ascertain its applicability for measuring milk composition under actual plant sampling procedures.

PROCEDURES

A 4-ounce sample from the individual farm bulk tank was taken twice weekly from December 1957 through April 1958 from each of 21 farms shipping milk to the Michigan State University dairy plant. These fresh samples (31 to 34 for each farm) were tested for fat by the Babcock method and total solids by the Mojonnier method and the small Watson-pattern lactometer. These testing methods were the same as described previously by Madden and Brunner.[3]

[1] These studies were supported in part by the Dairy Cattle Research Branch of the Agricultural Research Service, U.S.D.A.

[2] Watson, P. D. (1957). Determination of the solids in milk by a lactometric method at 102° F. Jour. Dairy Sci. 40: 394-402.

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RESULTS AND DISCUSSION

Samples tested totaled 691. These ranged from 3.2 to 6 percent fat and are grouped by fat levels in Table 1. The average differences in total solids as measured by the two methods ranged from –.02 to .11 percent total solids for the various fat levels and .01 percent overall. These differences were not statistically significant and have no practical significance since the average differences are less than 1 percent of the measurement. The correlations between total solids measurements by the two methods varied with fat levels (Table 1). These correlations are statistically significant except for the 6 percent fat level with limited observations.

TABLE 1—Comparison of Mojonnier (M) and lactometric (L) methods for measuring total solids of herd milks

Fat ranges	Number of samples	Average			Average(*a*) differences	Correlation(*b*)
		Fat	T.S.(M)	T.S.(L)		
		(percent)				
3.5.....	62	3.4	11.77	11.66	.11	.39
3.5—3.9.....	407	3.7	12.16	12.18	−.02	.74
4.0—4.4.....	72	4.2	13.06	13.03	.03	.86
4.5—4.9.....	51	4.6	13.80	13.71	.09	.40
5.0—5.4.....	20	5.2	14.54	14.53	.01	.91
5.5—5.9.....	73	5.6	15.14	15.12	.02	.35
6.0+.....	6	6.0	15.61	15.50	.11	.25
All.....	691	4.0	12.75	12.74	.01	.97

(*a*) Average total solids for the two methods are not significantly different at $P = .05$.
(*b*) All correlations (except for the 6 percent level) are significantly different from zero at $P < .05$.

The low magnitude of several of the correlations suggested some unusual variations in measurements. Upon examination of the data, three extreme Mojonnier measurements were noted where T.S. (M) differed from T.S.(L) by 4.79, 2.24, and –1.44 for the fat percent levels under 3.5, 4.5 to 4.9, and 5.5 to 5.9, respectively.

When the data for these three samples were removed, the correlations for these fat levels became .85, .43, and .41, respectively. The overall correlation increased to .99. The tedious nature of the Mojonnier method renders it subject to more errors in technique and recording than the lactometric method and may account for these discrepancies.

Deviations of total solids as measured by the two methods were in the following ranges: (a) 41 percent of the samples differed by less

than ±.10 percent; (b) 75 percent of the samples differed by less than ±.20 percent; (c) 89 percent of the samples differed by less than ±.30 percent; and (d) 96 percent of the samples differed by less than ±.40 percent.

Differences between fat levels, between methods, and the interaction of fat levels and methods were studied in an analysis of variance. The methods of measurement did not differ significantly. The lack of a significant interaction indicated that the relationships between these two methods did not differ at various fat levels. The significant differences in total solids at various fat levels is generally recognized.

SUMMARY

Milk samples from 21 herds were tested for fat by the Babcock method and for total solids by the Mojonnier method and the small Watson-pattern lactometer. A total of 691 samples (31 to 34 samples per herd) from December 1957 to April 1958 were tested. The two methods did not differ significantly in measuring total solids. Since this lactometric method requires a small sample, is less tedious, more rapid, and does not differ significantly from the Mojonnier method, the former method is recommended for the measurement of total solids in herd milk.

EFFECT OF HUMIDITY ON GROWTH OF SELECTED ORNAMENTAL PLANTS

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IN AN ATMOSPHERE of high relative humidity, plants have demonstrated increased growth,[1,2] an increase in leaf size,[3] a change in the number of leaves,[1,2] and the growth of thick, dark green leaves with thin cuticle and cell walls, in addition to loosely arranged palisade and spongy mesophyll with large intercellular spaces.[1]

The present investigation studied the influence of high and low humidity on the growth and leaf structure of a representative number of ornamental plants.

EXPERIMENTAL PROCEDURE

Plants to be studied were divided into two groups. Group 1 consisted of hardy coniferous plants: *Juniperus chinensis, Pinus nigra, Taxus cuspidata Andersoni, Taxus cuspidata capitata,* and *Taxus media Hicksi.* Group 2 consisted of less hardy, broad-leafed plants: *Cissus rhombifolia, Dracaena godseffiana, Peperomia obtusifolia variegata,* and *Scindapsus aureus.*

Two experimental chambers consisting of wooden frames supporting three shelves were constructed so that one chamber was enclosed with transparent "Saran-Wrap"[4] to conserve humidity, while the other chamber was left uncovered. Both chambers were located on a table in the laboratory facing an east window.

Eighteen of each of the Group 1 plants were potted in 4-inch pots on January 18, 1957, were pruned uniformly to within 5 inches of the

[1] Nightingale, G. T., and J. W. Mitchell (1934). Effects of humidity on metabolism in tomato and apple. Plant Physiol. 9:217-236.

[2] Newcombe, F. C., and E. T. Bowerman (1918). Behavior of plants in unventilated chambers. Amer. Jour. Bot. 5:284-294.

[3] Hanson, H. C. (1917). Leaf structure as related to environment. Amer. Jour. Bot. 4:533-560.

[4] A transparent plastic film manufactured by Dow Chemical Company, Midland, Mich.

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soil level, and grown in the greenhouse for 3 weeks before half of each species was transferred to each of the experimental chambers. Half of 20 rooted cuttings of each species of Group 2 plants, growing in 2½-inch pots, were placed in each chamber on Jan. 25, 1957.

All of the plants were watered as seemed necessary; temperatures and humidities were recorded by a Bendix-Friez hygrothermograph. Records of amount of water supplied, fresh and dry weight, and leaf thickness were compiled for Group 1 plants. In addition, plant height and leaf area were compiled for Group 2 plants.

Leaf area of Group 2 plants was measured by use of a planimeter. Leaf thickness of five leaves from each species of plant grown in low and high relative humidities was measured and the structure of leaves of *Taxus cuspidata capitata* and *Cissus rhombifolia* was observed by cutting a thin slice from the leaves across the mid-rib halfway between the base and tip, fixing, dehydrating, embedding in paraffin, cutting transections ten micra in thickness, and staining them in safranin and fast green, using standard processing techniques.

RESULTS

The average daily temperature over a 5-month period was 74.6° F. in the low humidity chamber and 77.2° F. in the high humidity chamber with average daily relative humidities of 34.4 percent and 91.9 percent respectively.

The range of temperatures from January to June for the low humidity chambers was 70 to 86° F. and 70 to 90° F. for the high humidity chamber. Temperatures varied from 1 to 4 degrees between the humidity chambers. The higher temperature variation occurred during the last 3 weeks of the experiment.

Throughout the experiment, it was apparent that plants in the drier atmosphere needed larger amounts of water more frequently. The difference in amount of water required by plants in the two treatments was striking. For an average of 45 Group 1 plants, the total water requirement over a 3-month period was 1.3 L. per plant in the low humidity chamber compared to .3 L. per plant in the high humidity chamber.

For the Group 2 plants in the low humidity, an average of 40 plants required a total of 1.2 L. of water per plant compared to .3 L. of water per plant in the high humidity. Much of this water requirement was because of evaporative water loss from the top of the soil as well as through the porous clay pots.

For Group 1 plants, there was no consistent increase in fresh or dry weight as a result of the difference in relative humidity (Table 1). Conifers did not grow well; some did not survive, but in general in high relative humidity, terminal shoots produced long, weak new growth.

TABLE 1—Average fresh weight, dry weight, and leaf thickness (10 plants per treatment)

Group 1 plants	Low humidity			High humidity		
	Fresh weight (gms.)	Dry weight (gms.)	Leaf thickness (micra) 5 leaves	Fresh weight (gms.)	Dry weight (gms.)	Leaf thickness (micra) 5 leaves
1. *Juniperus chinensis*	1.55	.75	343.75	2.03	.93	450.00
2. *Pinus nigra*	5.25	1.95	187.50	4.70	1.65	250.00
3. *Taxus cuspidata Andersoni*	....	....	.....	....	....	.....
4. *Taxus cuspidata capitata*	2.37	.77	181.25	2.45	.84	320.00
5. *Taxus media Hicksi*	2.70	1.01	253.75	2.30	.83	263.75

With Group 2 plants the results were different. All Group 2 plants with the exception of *Dracaena godseffiana* made more linear growth and weighed more when grown in high rather than in low relative humidity (Table 2). The three species which grew more rapidly produced larger, more numerous, darker green leaves.

TABLE 2—Average fresh weight, dry weight, plant height, leaf area, and thickness (10 plants per treatment)

Group 2 plants	*Cissus rhombifolia*		*Dracaena godseffiana*		*Peperomia obtusifolia variegata*		*Scindapsus aureus*	
Humidity	Low	High	Low	High	Low	High	Low	High
Fresh weight (gms.)	3.4	5.5	3.2	3.2	18.2	20.1	12.8	22.9
Dry weight (gms.)	.7	1.0	.8	.8	.89	.92	1.4	2.1
Average plant height to newest node (inches)	4.9	9.1	3.6	3.3	2.4	3.4	8.9	18.3
Average leaf area ($cm.^2$) 5 leaves	759.0	1082.0	638.0	557.0	800.0	950.0	1118.0	1642.0
Average leaf thickness (micra) 5 leaves	103.8	228.8	208.8	207.5	143.8	176.2	242.5	260.0

The outstanding differences in leaf structure were the greater thickness of leaves and increased weight of those plants grown in high relative humidity.

All of the leaves on plants grown in high humidity (with the exception of *Dracaena godseffiana*), were thicker (Tables 1 and 2). Leaves of Group 2 plants with the exception of *Dracaena* all produced leaves of larger area (Table 2).

Taxus leaves were much thicker when grown in the higher than in the lower relative humidity (Fig. 1, A and B). The epidermis on these thicker leaves (Fig. 1, A) consisted of a single row of large thin-walled

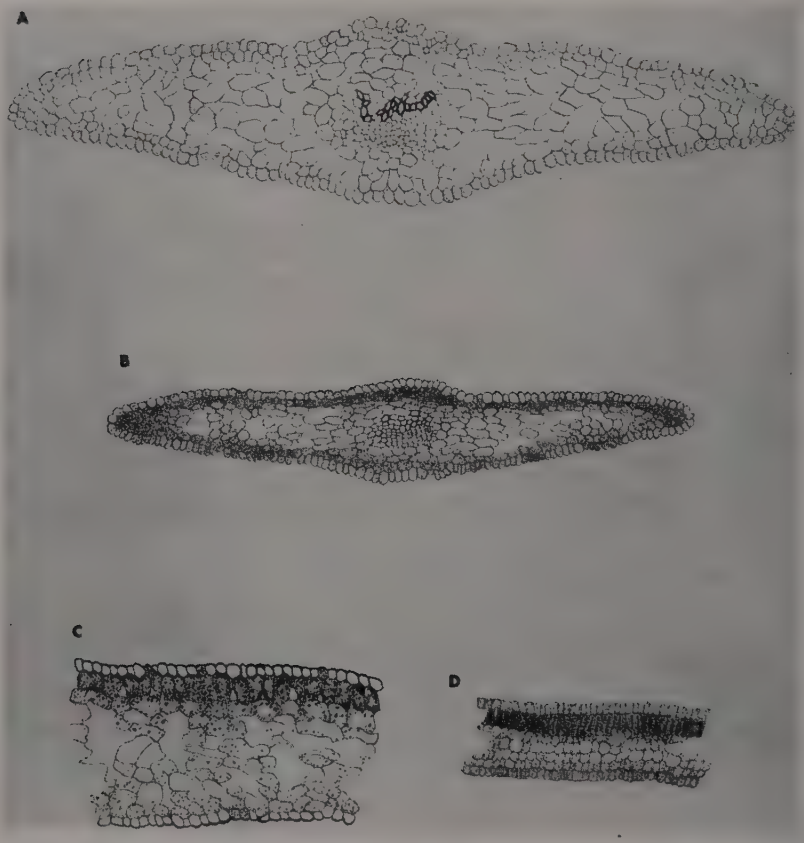

Fig. 1. A—Transection of leaf of Taxus cuspidata capitata from a plant grown in high humidity; B—transection of leaf of Taxus cuspidata capitata from a plant grown in low humidity; C—transection of leaf of Cissus rhombifolia from a plant grown in high humidity; D—transection of leaf of Cissus rhombifolia from a plant grown in low humidity.

cells with conspicuous deeply stained granular deposits resembling tannin. The leaf had much intercellular space and a large volume of mesophyll.

A single layer of epidermal cells with a heavy cuticle covered leaves of *Taxus* plants grown in low relative humidity (Fig. 1, B). Pyramidal cap-like peripheral cell wells were characteristic; intercellular space was fairly extensive but there were some densely compacted cells in the central bundle region and especially near the edges of the leaf.

Leaves of *Cissus* plants from high relative humidity were much thicker with more loosely arranged mesophyll than leaves from plants grown in low relative humidity (Fig. 1, C and D). Leaves from *Cissus* plants grown in high relative humidity were protected by a single epidermal layer (Fig. 1, C). A thick cuticle completely covered cells on the adaxial surface but the abaxial cells had thickened outer walls.

CONCLUSIONS

In order to determine the effects of humidity on the growth of plants, 80 broadleafed, less hardy plants (four species) and 90 young, hardy conifers (five species) were grown for 5 months in atmospheres of low and high relative humidity.

In an open chamber facing an east window, daily temperatures and relative humidities averaged 74.6° F. and 34.4 percent, respectively. Average temperatures and relative humidities of 77.2° F. and 91.9 percent respectively, were maintained in the covered chambers.

Plants grown in low humidity similar to that in most homes during the winter months, required approximately four times as much water and still did not produce as many, as large, or as thick dark green leaves as if they were grown at the higher relative humidity. The cells of these smaller leaves were smaller and more closely compacted containing more, smaller chloroplasts.

With the conifers tested, there seemed to be no relationship between plant weight and the humidity but with the less hardy, broadleaved plants, linear growth, fresh and dry weight were all superior in the high humidity chamber with the exception of *Dracaena godseffiana* which appeared to grow as well or slightly better under conditions of lower relative humidity.

IDARED

A PROMISING NEW APPLE VARIETY FOR COMMERCIAL PLANTING IN MICHIGAN

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DURING THE PAST 30 YEARS, more than 50 promising new apple varieties have been tested at the Michigan State University Graham Station, Grand Rapids, to determine their adaptation and value in Michigan. Some showed promise, while others were lacking in size and color of fruit, eating or processing quality, and productivity. Of these new seedling varieties, one in particular, the Idared (Fig. 1), has been outstanding over a period of years.

The Idared originated at the Idaho Agricultural Experiment Station, resulting from a cross of Wagener and Jonathan. It was released for testing to other experiment stations in 1952. This new variety was never formally introduced by the Idaho Agricultural Experiment Station because it was not readily adapted to the climate of that state. It does appear to be a very promising variety for Michigan.

The Idared fruits range from 2½ to 3½ inches in size and are of a very attractive shade of medium bright red. The color is solid, not striped. The apples are uniform in shape, with a smooth, light, waxy finish. The flesh is white with some occasional traces of pink. It is firm, crisp, and juicy, with a flavor resembling Jonathan. It has good dessert quality, and is rated good to very good for home culinary purposes. In preliminary processing tests, the Idared produced an acceptable processed product, but was inferior to the Northern Spy.

Most of the fruits, borne singularly on spurs, hang well at harvest time. The harvesting season corresponds with Northern Spy. The fruits keep exceptionally well in common storage. In cold storage they

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Fig. 1. The Idared apple. Solid bright red in color, round-oblate in shape, 2½ to 3½ inches in size, maturing at the time of Northern Spy. Originated at the Idaho Agricultural Experiment Station from a cross of Wagener and Jonathan.

can be held in good condition until June and July. Storage scald and Jonathan spot have been observed on the fruits in a very few instances. No internal breakdown has been found to date.

Trees of Idared were set in the Graham Station test orchard in 1945 and 1947. They began bearing fruit the third year and have since borne good to heavy crops annually. Early bearing and annual bearing are its outstanding characteristics. Comparing the yields of Idared trees with McIntosh for the first 12 years after planting, the Idared produced approximately 77 percent more fruit by weight than McIntosh, the latter being considered one of the heavier yielding varieties in Michigan.

The Idared tree appears equal to Jonathan in cold hardiness. Its growth is moderate and its size is intermediate. The branches grow more upright than those of Jonathan, but are thicker and more sturdy. An abundance of fruit spurs are found along the scaffold and lateral branches, encouraging a well-distributed crop of apples throughout the tree. The crotches are comparatively wide and strong, enabling the tree to carry heavy crops without serious breakage.

The blooming periods of Idared and Jonathan are very similar. No tests have been made to determine whether or not the Idared is as good for pollinizing other apple varieties as the Jonathan or what

varieties are best for pollinizing the Idared. Until such tests are made, it may be assumed that the Idared performs similarly to the Jonathan.

At the Graham Station, the Idared trees have been comparatively free from the apple diseases generally encountered. The fruit and foliage are apparently no more susceptible to apple scab (*Venturia inaequalis* [Cke.] Wint.) than the Jonathan. However, fire blight (*Bacillus amylovorus* [Burr.] Trev.) was found on a few scattered twigs during years when nearby Jonathan trees were badly blighted. Reports from an area south of Michigan are that fire blight has seriously damaged young trees of this variety in some seasons. It appears to be as susceptible as Jonathan to powdery mildew (*Podosphoera leucotricha* (E. and E.) Salm.).

In view of the over-all tree performance and fruit qualities exhibited by this variety at the Graham Station, the Idared apple should be considered as a worthy addition to the commercial apple varieties grown in Michigan. Some limited plantings of Idared have already been made in the state, and if the growers' interest in it is any criterion, additional plantings will continue to be made in the years ahead. However, it is suggested that any new variety, no matter how promising, should be set in moderation and not to the exclusion of other already proven varieties.

CHEMICAL THINNING OF PEACHES USING NAPHTHALENEACETIC ACID, N-1-NAPHTHYL PHTHALAMIC ACID, AND 3-CHLORO IPC

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INTRODUCTION

Naphthaleneacetic acid (NAA) was the first plant growth regulator to be reported as a possible thinning agent for peaches. Southwick, Edgerton, and Hoffman (1947) had little success in reducing the fruit set on Golden Jubilee, Elberta, and Valiant with either the sodium salt or the methyl ester of naphthaleneacetic acid at concentrations of 10 to 40 p.p.m. when applied any time during the period of full bloom to 20 days after bloom.

Murneek and Hibbard (1947) also reported unsuccessful thinning of peaches with NAA at the same concentrations and periods of application. Three years later, Hibbard and Murneek (1950) found that NAA applied 35 days after full bloom on Elberta at 40 to 60 p.p.m. significantly reduced fruit set. Their explanation of the thinning action was that the embryo is resistant to inhibition by NAA during its inactive stage of approximately 23 days after fertilization.

Tukey (1933) reported that the peach embryo is arrested in development until approximately 40 days after full bloom. This discrepancy for the inactive period of the peach embryo may be due to seasonal, varietal, and geographical differences.

Batjer and Hoffman (1952) reported favorable peach thinning with 10 to 30 p.p.m. of NAA applied 30 days after full bloom. Earlier applications were found to be ineffective. They attributed the ineffective thinning with NAA when applied shortly after bloom to the limited leaf surface for absorption of the thinning agent. Kelley (1952, 1953, 1954, and 1955) also reported favorable peach thinning with NAA.

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A second material, 3-chloro-isoproply-N-phenyl carbamate (3-chloro IPC) was first reported by Marth and Prince (1953) as being effective in thinning peaches at concentrations of 200 and 500 p.p.m. when used 30 and 42 days after full bloom. They also reported that treated fruits matured earlier and were softer than those not treated. However, no foliage injury occurred as when naphthaleneacetic acid was used.

Kelley (1953) observed effective thinning with 3-chloro IPC 2 weeks after shuck-off, 42 days after full bloom, on Elberta at 200 p.p.m. and on Halehaven at 400 p.p.m., but extensive fruit injury resulted.

Horsfall and Moore (1956) found satisfactory thinning of Halehaven with 3-chloro IPC at 200 to 300 p.p.m. applied 35 to 48 days after full bloom and of Elberta at 300 p.p.m. applied 38 to 40 days after full bloom. In all cases hand thinning had to supplement the chemical thinning.

Recently, Edgerton, and Hoffman (1955) reported thinning of Redhaven, Halehaven, Elberta, and July Elberta with N-1-naphthyl phthalamic acid (NPA). This material was found to be most effective when used approximately 3 days after full bloom. They suggested a concentration range of 150 to 400 p.p.m. depending on the variety. Burkholder and Armstrong (1956) substantiated these findings.

Westwood (1956) was successful using NPA at 200 to 300 p.p.m. 1 week after full bloom on Elberta and Redhaven. Westwood favored the later application to eliminate the danger of thinning before a possible late killing frost.

Since chemical thinning presents a means of eliminating an expensive procedure of thinning peaches with hand labor, the peach thinning trials reported herein were carried on in 1955, 1956, and 1957 to evaluate the plant growth regulator chemicals, NAA, NPA, and 3-chloro IPC, under Michigan conditions.

MATERIALS AND METHODS

The treatments utilized in this series of study were conducted on trees of medium vigor at the K. D. Bailey Farm in the Pontiac area in 1955, at the Michigan State University Horticultural Farm, East Lansing, in 1956 and 1957, and at the Graham Experiment Station, Grand Rapids, in 1957.

Each treatment consisted of a minimum of five trees with three to four branches per tree used for blossom and fruit counts. The branches

were selected in different areas of the tree, and approximately 500 blossoms or fruit per tree were used for observation. Final fruit set counts were made at the end of July as it was noted that fruit on the NPA treatments continued to drop long after the so-called "June drop."

Firmness of the fruit was evaluated in 1956 and 1957 at the beginning and during harvest. The readings were made at four locations on the fruit, the dorsal and ventral sutures, and the two cheeks, with a Magness-Taylor pressure tester using a 7/16 inch plunger. This was used as an index of peach maturity based on the findings of Rood (1957). The size of the harvested fruit was recorded only in 1956 using standard fruit sizing rings.

All fruit thinning treatments were applied with a hand gun using 500 pounds pressure and spraying to the drip point.

The plant regulator treatments for fruit thinning were as follows:

1. NPA was used on Redhaven and Halehaven approximately 3 days after full bloom at 200 and 400 p.p.m. at the Bailey Farm in the Pontiac area in 1955, at 300 p.p.m. at the Michigan State University Horticultural Farm, East Lansing in 1956 and 1957, and at 200 and 250 p.p.m. at the Michigan State University Graham Experiment Station, Grand Rapids in 1957.

2. Applications of 3-chloro IPC were made on Redhaven and Halehaven at 300 p.p.m. 35 days after full bloom at the Bailey Farm in the Pontiac area in 1955, at 400 p.p.m. 28 days after full bloom at the Michigan State University Horticultural Farm, East Lansing, in 1956, and at the Michigan State University Graham Experiment Station, Grand Rapids in 1957.

3. NAA was used on Redhaven and Halehaven 2 weeks after shuck-off, 42 days after full bloom, at 30 p.p.m., at the Michigan State University Farm in 1957.

All applications were made under fast-drying conditions, except for one night application of NPA in 1956. This treatment was made at approximately 8:30 p.m. to assimilate slow-drying conditions.

RESULTS AND DISCUSSION

Thinning: The findings from the use of NPA, 3-chloro IPC, and NAA as thinning agents for Redhaven and Halehaven peaches are given in Table 1.

TABLE 1—Fruit thinning resulting from the use of naphthaleneacetic acid, 3-chloro IPC, and N-1-naphthyl phthalamic acid on Redhaven and Halehaven peach trees

Material	Season	Location	Time of application (days after full bloom)	Concentration (p.p.m.)	Redhaven		Halehaven	
					Set per 100 blossoms	Relative thinning effectiveness(*a*)	Set per 100 blossoms	Relative thinning effectiveness(*a*)
NPA.....	1955	Pontiac.....	3	200	6.8	.49	20.8	1.12
NPA.....	1955	Pontiac.....	3	400	5.1	.40	13.7	.73
Control.....	1955	Pontiac.....	..	...	12.9	1.00	18.7	1.00
NPA.....	1956	East Lansing.	3	300 (day)	3.3**	.16	8.3**	.22
NPA.....	1956	East Lansing.	3	300 (night)	4.2**	.21	7.1**	.19
Control.....	1956	East Lansing.	..	...	20.4	1.00	37.6	1.00
NPA.....	1957	Grand Rapids.	3	200	13.3	.78	23.7	.89
NPA.....	1957	Grand Rapids.	3	250	12.2	.71	26.0	.97
Control.....	1957	Grand Rapids.	..	...	17.0	1.00	26.7	1.00
NPA.....	1957	East Lansing.	3	300	31.8**	.69	41.6**	.69
Control.....	1957	East Lansing.	..	...	46.0	1.00	59.9	1.00
					Set per 100 fruit		Set per 100 fruit	
3-chloro IPC	1955	Pontiac.....	35	300	21.4*	.55	31.8	.81
Control.....	1955	Pontiac.....	..	...	38.9	1.00	38.9	1.00
3-chloro IPC	1956	East Lansing.	28	400	15.5*	.62	19.4**	.52
Control.....	1956	East Lansing.	..	...	25.4	1.00	37.6	1.00
3-chloro IPC	1957	Grand Rapids.	28	300	18.6	.62	22.8	.52
Control.....	1957	Grand Rapids.	..	...	29.7	1.00	43.6	1.00
NAA.....	1957	East Lansing.	42	30	27.4**	.49	63.2	.77
Control.....	1957	East Lansing.	..	...	63.3	1.00	82.4	1.00

*Significantly less fruit set than control at 5 percent level.
**Significantly less fruit set than control at 1 percent level.
(*a*) Relative thinning effectiveness is the fruit set of each treatment divided by the fruit set of the corresponding control.

In 1955 fruit set on Redhaven trees in the Pontiac area, sprayed with NPA at 200 and 400 p.p.m. was not significantly different from the control treatment (Table 1). However, NPA applied at 300 p.p.m. in 1956 in East Lansing on the same variety resulted in overthinning (3.3 percent fruit set as compared to 20.4 percent for the control trees). There was no significant difference, however, between day and twilight applications made in 1956 (3.3 and 4.2 percent fruit set respectively).

Because of the overthinning at 300 p.p.m. in 1956, NPA was used at 200, 250, and 300 p.p.m. in 1957. No significant thinning occurred at the two lower concentrations in 1957 (Table 1), and even though there was significant thinning at 300 p.p.m., the set was still too heavy (31.8 percent as compared to 46.0 percent for the control trees).

The reduction in fruit set on Redhaven trees with 3-chloro IPC at 400 p.p.m. in 1956 was significant, but when used at the same concentration in 1957, no thinning was apparent. However, in both 1956 and 1957, Redhaven trees receiving the 3-chloro IPC treatment produced unfavorable "beak-shaped" peaches (Fig. 1). Not only were the peaches misshapen, but the "beaked" portion became soft when the peaches reached the firm-ripe stage making them easy to bruise, a condition very favorable for the development of brown rot.

The use of NAA in 1957, 2 weeks after shuck-off, at 30 p.p.m. on the Redhaven variety, gave very significant thinning with a heavy fruit drop occurring about 2 weeks after the application, concurrently with

Fig. 1. Injury on Redhaven peaches from 3-chloro IPC. Top row: uneven development of the fruit; middle row: undesirable enlargement of base of the style, "Beaked Fruit"; bottom row: desired shape for mature Redhaven peaches.

the "June drop." Terminal injury to the trees from the application of NAA was apparent but did not appear to be of commercial importance.

The Halehaven variety was not thinned significantly in 1955 with applications of NPA at concentrations of 200 and 400 p.p.m. However, when NPA was applied at 300 p.p.m. in 1956, significant thinning resulted. There was no apparent difference in the amount of thinning between the day and night applications of NPA (Table 1). As for Redhaven, the applications of NPA at 200 and 250 p.p.m. made in 1957 on Halehaven did not reduce the fruit set significantly. Owing to an unaccountable error, no results were available from the use of 300 p.p.m. on Halehaven in 1957.

Even though 3-chloro IPC at 400 p.p.m. significantly reduced fruit set of Halehaven in 1956 and 1957, the trees required hand-thinning. Also, a large portion of the Redhaven fruits (Fig. 1) had an unfavorable "beaked" appearance characteristic of one form of 3-chloro IPC injury occurring in Michigan.

The NAA application at 30 p.p.m. 2 weeks after shuck-off on 9-year-old Halehaven trees reduced the fruit set significantly, but some hand-thinning was necessary (Table 1). Foliage injury on Halehaven trees was not as severe as on Redhaven. However, the use of the same spray mixture of NAA on 4-year-old Halehaven trees caused all of the fruit to turn brown and drop 2 weeks after the application. Some terminal shoot and leaf injury was observed on these trees.

Fruit Firmness: Data of firmness of the peaches at harvest time as affected by the various thinning materials for the years of 1956 and 1957 are summarized in Table 2.

Redhaven fruits of the NPA treatments made in East Lansing in 1956 reached maturity, as measured by firmness of flesh, approximately 3 days earlier than those of the control treatments. It was conjectured that this earlier maturity was related to the light fruit set on the treated trees rather than to the NPA treatment.

In 1957, there were no significant differences in firmness of fruit treated with NPA and those untreated (Table 2). Since in 1957 the fruit set was not reduced by NPA at 200 p.p.m. or at 250 p.p.m., it seems apparent that in 1956 NPA had no direct effect on the maturation of the fruit. Thus, the earlier ripening in 1956 probably was the result of the reduction of fruit set, 3.3 and 4.2 percent set as compared to 20.4 percent set for the control treatment (Table 1).

TABLE 2—Firmness of Redhaven and Halehaven peaches at harvest as effected by various plant regulator thinning sprays in 1956 and 1957

Treatments	Conc. (p.p.m.)	Redhaven			Halehaven			
		Aug. 11	Aug. 14	Aug. 17	Aug. 28	Aug. 30	Sept. 4	Sept. 11
1956		Fruit firmness (lbs. per sq. in.)						
East Lansing								
NPA	300	....	16.0**	1.2**	....	....	7.7**	.9*
3-chloro IPC	400	....	10.9	2.2**	....	....	6.3*	2.2
Control	...	....	26.1	18.7	....	....	20.4	3.2
1957								
East Lansing								
NAA	30	25.4	....	....	....	16.3	....	...
NPA	300	22.9	....	....	....	17.9	....	...
Control	...	24.1	....	....	....	15.8	....	...
Grand Rapids								
NPA	200	....	20.3	....	17.4	....	....	...
NPA	250	....	20.5	....	17.6	....	....	...
3-chloro IPC	400	....	16.3**	....	7.1**	....	....	...
Control	...	....	21.1	....	12.5	....	....	...

*Significantly less fruit firmness than control at 5 percent level.
**Significantly less fruit firmness than control at 1 percent level.

Redhaven fruits on trees treated with 3-chloro IPC were less firm in both 1956 and 1957 than those of the control treatment.

The use of NAA as a thinning agent had no influence on the rate of ripening of Redhaven fruit in 1957 as measured by firmness of the flesh (Table 2).

As found for the Redhaven in 1956, Halehaven fruits on NPA-treated trees matured a few days earlier than the untreated fruit when evaluated by firmness of flesh. Here, also, early maturity appeared to be the result of reduced fruit set on the NPA-treated trees rather than a direct ripening influence of the NPA compound, for there were no differences in firmness of flesh between the NPA and control treatment in 1957 (Table 2).

The use of 3-chloro IPC as a thinning agent on Halehaven in 1956 and 1957 resulted in earlier ripening of the fruit when compared with the control treatment. It is possible that the 3-chloro IPC was responsible for the earlier ripening of the treated fruit of both Redhaven and Halehaven as the reduction in fruit set, though significant, was not excessive.

Fruit Size: The size range of 100 peaches picked at harvest time from the different thinning treatments made in East Lansing in 1956 are found in Table 3.

TABLE 3—Size of Redhaven and Halehaven peaches as influenced by the use of N-1-naphthyl phthalamic acid and 3-chloro IPC as thinning sprays

Variety	Redhaven			Halehaven		
Material concentration (p.p.m.)	Control	NPA 300	3-chloro IPC 400	Control	NPA 300	3-chloro IPC 400
	Size range of 100 peaches at harvest					
1⅛—2 in.....	89	0	6	33	11	25
2—2¼ in.....	11	0	69	36	33	64
2¼—2¾ in.....	0	56	25	31	56	11
2¾—3½ in.....	0	44	0	0	0	0

As expected, the degree of thinning resulting from the chemical treatments directly influenced the size of the harvested peaches. The Redhaven and Halehaven peaches from the NPA treatments were the largest, and these trees were thinned the heaviest. The Redhaven peaches from the 3-chloro IPC treatments were intermediate in size, and those from the Halehaven trees treated with 3-chloro IPC and from the untreated trees were the smallest.

Relative Thinning Effectiveness: In order to compare the relative effectiveness of a chemical to reduce fruit set over a 3-year period, all the control treatments were given a base number of one (1.0) on the basis of no applied influence for reduction in fruit set. Fractional numbers for the chemical treatments were obtained for each year by dividing the fruit set resulting from individual treatments by the fruit set of its corresponding control treatment.

This fractional number reflects the relative effectiveness of a chemical to reduce fruit set when comparing treatments in any given year or when comparing the performance of a thinning chemical over a period of years. The numbers reflecting the relative effectiveness of the chemicals used in this study to reduce fruit set are given in Table 1.

As shown by the data of relative thinning effectiveness in Table 1, reduction in fruit set of Redhaven trees from the use of NPA in 1956 was much more excessive than in either 1955 or 1957. By contrast, the relative effectiveness of 3-chloro IPC to reduce fruit set varied little during the 3-year period, .55, .62, and .62 (Table 1). Results similar to Redhaven were found for Halehaven. The variation from the use

of NPA as a thinning agent was very excessive over the 3-year period, while the results from the use of 3-chloro IPC were more uniform (Table 1).

It has been conjectured that the ability of NPA to reduce fruit set may be dependent upon the environmental factors affecting rate of absorption at the time of application. In 1955 and 1957, the NPA treatments were made when the air temperatures were below 65 degrees F., while in 1956 the air temperature was above 70 degrees F. Conditions were favorable for rapid drying at time of application in 1955, 1956, and 1957, except at the Graham Experiment Station in 1957 when the weather was damp and humid. The factors, relative humidity and air temperature, as related to rate of absorption of NPA, need further investigation.

SUMMARY

Peach thinning sprays of NPA, 3-chloro IPC, and NAA were applied to Halehaven and Redhaven trees in 1955, 1956, and 1957 with the following results:

1. Redhaven trees were overthinned by NPA at 300 p.p.m. applied 3 days after full bloom in 1956. However, the use of NPA at 200 and 400 p.p.m. in 1955 and 200, 250, and 300 p.p.m. in 1957 did not over-thin. Trees treated in 1957 required further hand-thinning.

2. In 1956 Halehaven trees were thinned significantly with 300 p.p.m. of NPA applied 3 days after full bloom. Applications of NPA at 200 and 400 p.p.m. in 1955 and at 200 and 250 p.p.m. in 1957 did not result in significant thinning.

3. The use of 3-chloro IPC at 400 p.p.m. on Redhaven and Halehaven 4 weeks after bloom in 1956 and 1957 did not thin sufficiently to eliminate hand-thinning. It did hasten ripening of the fruit as measured by firmness of flesh and did result in unfavorable "beaked" peaches (Fig. 1). Because of the resulting misshapen fruit of both the Redhaven and Halehaven varieties, 3-chloro IPC is not suggested for peach thinning in Michigan.

4. Fruit size of Redhaven and Halehaven was increased in 1956 by the use of NPA at 300 p.p.m. However, the use of 3-chloro IPC at 400 p.p.m. increased the size of the fruit of only the Redhaven variety.

5. NAA at 30 p.p.m. applied 2 weeks after shuck-off in 1957 gave significant fruit thinning of both Redhaven and Halehaven and may warrant re-evaluation as a thinning agent for peaches. Although some terminal flagging occurred, twig and leaf injury did not appear to be of commercial importance.

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THE EFFECT OF FEEDING RESERPINE TO GROWING BIRDS

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THE TERM "TRANQUILIZATION" connotes a reduction in physical activity. Thus, the use of a tranquilizer at low levels might conserve energy for added body growth and still maintain normal food consumption.

Berger (1956) reported that the tranquilizer drug, meprobamate, had a muscle-relaxant action and taming effect on mammals. Babcock and Taylor (1957) showed that meprobamate fed in relatively large amounts to White Leghorn cockerels, produced no visible effect other than growth inhibition. Garren and Hill (1957) fed meprobamate and promazine to Leghorns at levels of 275 and 550 p.p.m. They found that these tranquilizers did not lessen the characteristic nervousness of the birds but did retard weight gains.

Hewitt and Reynolds (1957) fed 5 p.p.m. of reserpine to pheasants and found that feather picking was reduced but the rate of gain was also reduced to some extent. Carlson (1956), feeding reserpine to turkeys at levels equivalent to .1 and 1.0 p.p.m., reported a decrease in weight gains but observed less fighting in mixed groups of toms and hens.

Van Matre, Burger, and Lorenz (1957) fed chlorpormazine and reserpine to chickens older than 4 weeks of age and demonstrated a significant protection against heat stress.

In this study, reserpine was fed to heavy breed female chicks to determine the effect on growth and feed efficiency and on the circulatory and endocrine systems.

EXPERIMENTAL PROCEDURE

One hundred-sixty White Rock cross female chicks were selected at 4 weeks of age for uniform weight and rate of gain. They were divided into groups of 10 with four groups per treatment.

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Reserpine[1] was incorporated in a commercial 20 percent chick starter at two levels, 0.1 and 1.0 p.p.m. and fed from the fourth thru the seventh week of age. A third treatment of 3.7 p.p.m. of phenobarbital in the feed and a fourth as a control, served as comparison groups.

RESULTS AND DISCUSSION

Effect on Weight Gain and Feed Conversion

Individual body weights and the feed consumption of the chicks on each treatment were recorded each week. The average body weight in grams of the 40 pullets on each treatment at 4 weeks of age, the gain per bird on each treatment, and the feed conversion factors are shown in Table 1.

TABLE 1—The effect of feeding reserpine on weight gains and feed conversion

Treatment	Average 4-week weight (grams)	Gain per bird (grams)	Feed/Gain
Control	321.9	702.3	3.02
3.7 p.p.m. phenobarbital	325.7	692.2	2.83
.1 p.p.m. reserpine	320.8	674.4	2.79
1.0 p.p.m. reserpine	323.7	687.3	2.86

An analysis of variance of these data showed no significant differences in weight gain. The feed conversion of the treated groups showed a slight advantage compared to the control group. This improvement of 0.2 pounds less feed required per pound of gain would justify the additional cost of the tranquilizer and may prove to be economically profitable to a large producer.

The previous hypothesis that tranquilizers reduce physical activity and therefore diminish energy expenditure was not substantiated in this trial since no signs of sedation were noted in the groups fed tranquilizers. Possibly small doses of the drug exert a protective effect against environmental stress which is not evident in the birds' gross behavior or otherwise (Hale, 1958).

[1] Liquid Reserpoid, supplied by the Upjohn Company, Kalamazoo, Mich.

Effect on Organ Weights and Radiophosphorous Uptake

On the fifty-sixth day, one-half of the birds on each treatment were injected with 990 microcuries of radiophosphorous (p^{32}) 2 hours prior to slaughtering to determine the uptake of radioactivity as a measure of growth. The thyroids, adrenals, ovaries, oviducts, and pituitaries were weighed and wet ashed in a planchet with 2 cc. of nitric acid for preparation of a uniform sample. After the samples were digested and the nitric acid was evaporated, the activity of each was recorded (with corrections for shelf position and decay). One thousand counts per sample were taken to establish a standard deviation of 3 percent in the observed counting rate.

The mean weights of the endocrines and their end organs after treatment are shown in Table 2. The group fed 1.0 p.p.m. reserpine

TABLE 2—Organ weights(a) of White Rock crosses at 8 weeks of age (Mean ± Standard error)

Treatment	Ovary	Oviduct	Pituitary	Thyroid	Adrenal
	(mg.)	(mg.)	(mg.)	(mg.)	(mg.)
Control	264 ± 10.0	142 ± 10.4	8.9 ± 0.73	129 ± 9.5	89 ± 5.3
3.7 p.p.m. phenobarbital	280 ± 12.9	137 ± 8.0	11.0 ± 1.6	135 ± 9.0	91 ± 6.5
.1 p.p.m. reserpine	258 ± 11.7	129 ± 6.4	8.8 ± 0.76	122 ± 7.1	81 ± 5.1
1.0 p.p.m. reserpine	297 ± 11.6	133 ± 8.3	10.9 ± 1.26	125 ± 9.9	83 ± 6.5

(a) All weights consist of 20 birds except pituitary weights which have at least 14 per treatment.

showed increased ovarian weights at 56 days of age compared to the other groups. This difference was significant at the .05 level using the "t" test. However, at 77 days of age this difference was not apparent.

Radioactivity per milligram of tissue in counts per minute corrected for zero time of decay are shown in Table 3. An analysis of

TABLE 3—Radioactivity(a) per milligram of tissue

Treatment	Ovary	Oviduct	Adrenals	Thyroid	Pituitary
Control	3.67	3.62	4.41	2.61	2.56
3.7 p.p.m. phenobarbital	3.72	4.21	7.35	2.90	2.72
.1 p.p.m. reserpine	4.81	4.09	5.14	2.68	2.34
1.0 p.p.m. reserpine	3.57	5.23	3.65	2.70	2.49
Pooled St. error of mean	0.39	0.61	1.30	0.24	0.36

(a) In counts per minute corrected for zero time of decay.

variance showed no significant difference between treatments when radiophosphorous uptake of specific organs was measured two hours post-injection.

Effect on Hemodynamics

At 73 days of age, blood pressure was determined directly, to evaluate the effect of the tranquilizer on the circulatory system. An injection of 0.5 cc. of a 1:25,000 dilution of epinephrine (used as a constant, known stress) was administered intravenously. Systolic, diastolic, pulse pressure, and heart rate before stress and after stress were obtained. The hemodynamics of these birds following tranquilizer feeding are given in Table 4 as absolute figures. No significant difference was found between control and treated birds. The percentage change in hemodynamics may be seen in Table 5. Again these data showed no significant difference. However, a trend toward an increased systolic and pulse pressure of the treated birds after stress, as compared to control, suggested a slight response to the treatments.

TABLE 4—Hemodynamics of chickens following tranquilizer feeding

Treatment	Number of birds	Systolic B.P.	Diastolic B.P.	Pulse pressure	Heart rate
Control	14	136.2	111.9	24.4	403.4
3.7 p.p.m. phenobarbital	12	131.0	108.7	22.3	410.8
.1 p.p.m. reserpine	14	139.7	118.3	21.4	419.5
1.0 p.p.m. reserpine	17	137.2	114.7	22.5	414.4

TABLE 5—Percent change in hemodynamics following a given stress(a)

Treatment	Number of birds	Systolic B.P. (percent increase)	Diastolic B.P. (percent increase)	Pulse pressure (percent increase)	Heart rate (percent decrease)
Control	13	50.51	32.26	144.34	11.22
3.7 p.p.m. phenobarbital	12	57.32	35.52	221.15	23.50
.1 p.p.m. reserpine	14	57.56	32.68	206.28	13.53
1.0 p.p.m. reserpine	14	56.72	33.57	185.17	15.42

(a) Intravenous injection of 0.5cc of 1/25000 dilution of Epinephrine.

The Effect on Ovarian Weight, Oviduct Weight, Comb, and Abdominal Fat Weight at 11 Weeks of Age

The second half of the birds on each treatment were continued on their respective feeds until 10½ weeks of age. At 11 weeks the birds were slaughtered. The ovarian, oviduct, comb, and abdominal fat weights are given in Table 6. No significant difference was found between control and treated birds.

TABLE 6—The effect of tranquilizers at 11 weeks of age on the ovary and the end organs of its secretion (Mean ± Standard error)

Treatment	Ovary	Oviduct	Comb	Abdominal fat
	(mg.)	(mg.)	(mg.)	(gm.)
Control	506.2 ± 21.2	271.0 ± 18.6	322.5 ± 29.0	40.4 ± 6.4
3.7 p.p.m. phenobarbital	471.2 ± 18.4	254.5 ± 13.5	286.1 ± 25.9	28.0 ± 3.9
.1 p.p.m. reserpine	473.7 ± 13.8	277.2 ± 17.1	265.8 ± 19.6	38.3 ± 5.2
1.0 p.p.m. reserpine	513.1 ± 27.3	283.6 ± 19.4	311.6 ± 36.7	36.8 ± 4.3

Effect on Pituitary Assay

A pituitary assay (Nakajo and Imai, 1956) was made to determine the effect of reserpine on the hormone content of the pituitary. The results are given in Table 7. The mean gonad weights of the assay chicks for each treatment, together with the increase in gonad weight expressed as chick units (Breneman, 1945), are also shown.

TABLE 7—Pituitary assay

	Number of birds	Mean weight(*a*) (mg.)	Chick units(*b*)
Saline control	20	3.39	....
Control pituitary	8	5.22	1.54
Phenobarbital pituitary	11	5.70	1.94
.1 p.p.m. reserpine pituitary	9	5.75	1.98
1.0 p.p.m. reserpine pituitary	8	6.05	2.24

(*a*) Mean gonad weights of the injected chick of the individual treatments.
(*b*) A chick unit equals a 35 percent increase of gonad weight of injected animal over the saline control. (Breneman, 1945, Endocrinology 36:190.)

SUMMARY

Under the conditions of this experiment and with the particular birds used in this study, the feeding of reserpine or phenobarbital at the given levels showed no significant differences on hemodynamics, radiophosphorus uptake, specific organ weights, comb, and abdominal fat weight, and gonadotrophin content of the pituitary.

An increased ovarian weight was found at 56 days of age but disappeared at 77 days in the group fed 1.0 p.p.m. of reserpine. However, no other significant difference was found in any specific organ weight.

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DESTRUCTION RATES OF MS 102 IN MILK USING IRRADIATION AND IRRADIATION PLUS HEAT

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DEPARTMENTS OF AGRICULTURAL ENGINEERING AND MICROBIOLOGY AND PUBLIC HEALTH

MILK IS A PERISHABLE COMMODITY that must be preserved as it moves in the marketing channels. The development of sources of ionizing radiations stimulated interest in their use to preserve milk, thereby reducing or eliminating the need for pasteurization and refrigeration.

The general field of radiation preservation of milk has been recently reviewed by Goldblith and Proctor[1] and Bierman, Proctor, and Goldblith.[2] The flavor problems accompanying irradiation is the chief deterrent to progress in this area. The threshold doses at which an off-flavor is induced by high voltage cathode rays, ranged from about 7,000 to 25,000 rep. (Roentgen equivalent physical). The acceptability of the irradiated products decreased with increased dosage.

Since the low doses cited above produce an off-flavor but are too low for preservation, a combination of irradiation plus a heat treatment might have advantages. Kempe reported that spores of *C. botulinum* are more easily killed by heat after irradiation.[3]

This study was instigated to determine the effect of irradiation and irradiation plus heat on the destruction characteristics of vegetative micro-organisms; specifically, vegetative cells of the heat resistant organism Micrococcus species 102.

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[1] Goldblith, S. A., and B. E. Proctor (1956). Radiation preservation of milk and milk products. I. Background and problems. Jour. Dairy Sci. 39 (4): 374-379.

[2] Bierman, G. W.; B. E. Proctor, and S. A. Goldblith (1956). Radiation preservation of milk and milk products. II. Off-flavors in milk and cream induced by ionizing radiations as judged by organoleptic tests. Jour. Dairy Sci. 39(4): 379-391.

[3] Kempe, L. L. (1955). Combined effects of heat and radiation in food sterilization. Applied Microbiol. 3 (6): 346-353.

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EXPERIMENTAL PROCEDURE

Preparation of Culture

Micrococcus MS 102 was used as the test organism. Twenty-four hours prior to use, 10 tubes of trypticase agar were seeded with cells of MS 102 cultured at 98.6° F. (37° C.) for 36 hours. After incubation at the same temperature for 24 hours, each slant was washed with 5 ml. of M/15 phosphate buffer. The washings were pooled in a single bottle, thoroughly shaken, and filtered through a sterile fiber glass filter. This suspension was used for testing immediately after preparation.

Preparation of the Substrate

Homogenized milk was used as the substrate. Three hundred ml. of milk were placed in a sterile, stainless steel container equipped with a stirring device. The sterile container and the milk were placed in a constant-temperature water bath and given a laboratory pasteurization equivalent to 30 minutes at 160° F. (71.1° C.) as an initial phase of a test.

Following pasteurization, the container was removed from the water bath and placed in a –25° F. (–30.1° C.) freezer for 1 hour to bring the temperature of the homogenized milk from 160° to 70° F. (71.1 to 21.1° C.). The uniform 300 ml. of milk was inoculated by adding 10 ml. of the MS 102 suspension to the 300 ml. of laboratory pasteurized milk while in the stainless steel container. The container and product were then agitated for 3 minutes after which the sample was divided into two representative samples of 150 ml. each. These aliquots were identified as aliquot A and aliquot B.

Irradiation

Ten ml. samples were removed from aliquot A by means of a sterile hypodermic needle and deposited in sterile 8.5 cm. square bottomed petri dishes. These prepared samples were taken to the irradiation chamber where they were arranged on the irradiation conveyor. The glass covers were removed and replaced with polyethylene covers.

It was necessary to limit the quantity of milk in the individual dishes since the irradiation was being supplied by a 1-million volt, resonant transformer-type electron beam machine with penetration not exceeding .2 inches.

Following irradiation, the samples were re-combined to make one composite sample by transferring the irradiated milk from the petri dishes to a single sterile container. All tests were carried out at least in duplicate; four irradiation levels were used: 10,000; 20,000; 50,000; and 80,000 rep.

Heat Treatment

Five ml. of milk were placed in sterile screw-top vials. Six tubes were prepared from irradiated milk and six from non-irradiated milk. Five of the six tubes for each treatment were immersed in a constant-temperature water bath at 160° F. (71.1° C.). Tubes were removed

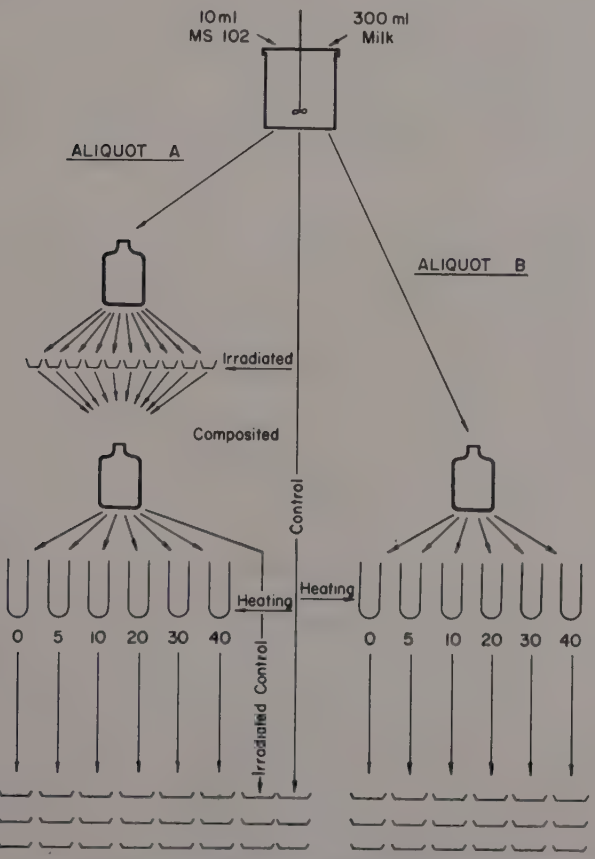

Fig. 1. Schematic diagram of procedure followed in carrying out experiment.

after 5, 10, 20, 30, and 40 minutes, and immediately placed in an ice bath until ready for plating. The sixth tube of milk served as a secondary control for errors that might accompany the heating and cooling operations. The primary control was a sample of milk from the original dilution placed in the ice bath during the heating operation.

Obtaining Bacteriological Results

Plate counts in three dilutions were made according to standard methods. The number of organisms present was determined in the initial sample, the composite irradiated sample, the five tubes of irradiated milk that were heated, the irradiated control, the five tubes of non-irradiated milk that were heated, and the control.

The plate counts were made by plating an aliquot on trypticase agar. After pouring, plates were placed in a 98.6° F. (37° C.) incubator for 72 hours after which they were counted and recorded. Fig. 1 (page 165) illustrates graphically the procedure followed in this project.

Results

The results are summarized in Table 1. (Results of replicate tests have been averaged arithmetically and these averages are presented in Table 1.)

TABLE 1—Summary of Results

Treatment	Heating time (minutes)	Number of organisms (10,000 rep.)	(20,000 rep.)	(50,000 rep.)	(80,000 rep.)
Control		15,000,000	39,600,000	21,600,000	24,200,000
Irradiated		11,400,000	14,200,000	1,800,000	1,220,000
Heated, but not irradiated	0	16,250,000	32,000,000	17,000,000	18,300,000
	5	8,700,000	19,100,000	7,900,000	12,300,000
	10	5,220,000	13,200,000	7,370,000	7,300,000
	20	1,787,000	7,610,000	562,000	44,200
	30	594,000	2,730,000	33,400	8,950
	40	21,700	186,000	708	930
Irradiated then heated	0	10,510,000	21,400,000	981,000	850,000
	5	1,593,000	6,560,000	316,000	70,200
	10	444,000	1,600,000	55,200	3,090
	20	151,000	947,000	542	400
	30	14,400	107,000	40	84
	40	2,530	10,500	10	12

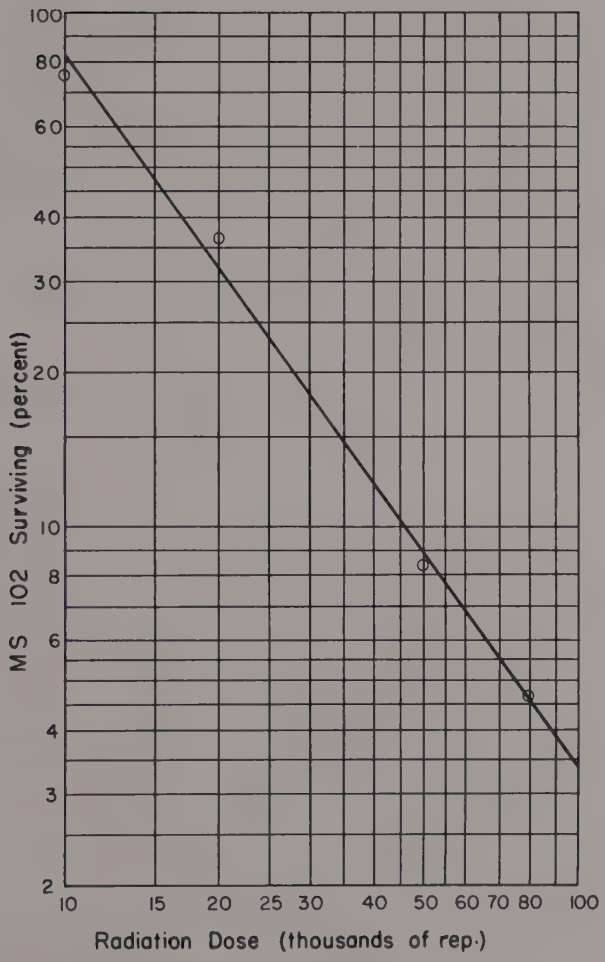

Fig. 2. Radiation survivor curve of MS 102.

It was found in these tests with MS 102 that there was a definite reduction in population due to irradiation. Fig. 2 illustrates the relationship of the irradiation dose and the reduction in population due to this irradiating dose plotted on log-log paper. A straight line fits the limited data quite well.

Table 2 lists the results obtained by comparing the heat destruction rates of populations of MS 102 that had been irradiated, with populations that had not been irradiated. The evaluation was made using average D values (D value is defined as the direction of a

survivor curve; one D value is the time in minutes required to reduce the bacterial population by 90 percent). The procedure used to obtain D values was to plot the number of survivors as a function of time for each test and then draw the best straight line through the points representing the number of survivors. The D value or direction of the rate of destruction curve was determined directly from this line. The D values in Table 2 are the average values for a given irradiation dosage.

TABLE 2—Heat destruction rates for irradiated and non-irradiated suspension of MS 102

Irradiation dose (rep.)	Average D value (min.)		Reduction in D of irradiated sample
	Irradiated	Control	
			(percent)
10,000	12.8	21.9	58.3
20,000	11.6	26.2	51.4
50,000	7.1	13.9	52.2
80,000	7.1	19.0	42.3

DISCUSSION

It was previously pointed out that a new culture was prepared for each test. Since the resistance of micro-organisms to heat varies between cultures, the D value of a culture grown one day cannot be compared directly to the D value of another culture. However, it was found that the reduction in D value, due to irradiation, was approximately 50 percent in all cases. While there was a difference between the 10,000 rep. dose and the 80,000 rep. dose, these are not significant at the 5 percent level even though there appears to be a trend. These results indicate that irradiation not only reduces the population, but increases their death rate after irradiation or reduces their D value. In the samples tested there was an average reduction in D value of about 50 percent.

SUMMARY

Micrococcus sp. MS 102 was studied regarding the effect of irradiation and irradiation combined with heat.

Four irradiation levels of 10,000, 20,000, 50,000, and 80,000 rep. were studied and all tests were carried out at least in duplicate. The

heat resistance of irradiated and non-irradiated samples of MS 102 was determined. It was found that irradiation itself reduces the bacterial population and appears to sensitize the bacteria in such a way that the rate of destruction of the organism is approximately doubled after irradiation.

Acknowledgment

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CONSUMERS' ATTITUDES TOWARD TRADING STAMPS

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THE PURPOSE OF THIS STUDY was to determine consumers' attitudes toward trading stamps and to relate these attitudes to certain family characteristics.

A previous study indicated that almost 90 percent of the families in Lansing, Michigan, saved trading stamps, many saving more than one kind of stamp.[1] The study also indicated that 70 percent of the families purchased most of their groceries from stores giving trading stamps.

Some argue that because consumers save stamps this indicates that they think they are a good thing, while others argue that consumers just cannot avoid the stamps.

What is the attitude of consumers toward trading stamps? To find out, four questions about trading stamps were asked of a random sample of consumers in Kalamazoo, Muskegon, Flint, and Grand Rapids, Michigan. These four questions constituted only a small part of the questionnaire. Most of the other questions dealt with the homemaker's knowledge in the area of food buying. The sample consisted of 1,000 addresses drawn from the city directory of each city. The survey was conducted by mail and was addressed to the homemaker. Of the 4,000 questionnaires sent out, 1,884 were answered. Another 187 were returned by the post office indicating that the home was vacant. Thus, the rate of return was about 50 percent. In addition to this, about three-fourths of the 457 non-respondents in Kalamazoo were interviewed in person to obtain some estimate of the nature of any non-response bias which might exist.

The four questions were in the form of statements for which the respondent was asked to check whether they agreed, disagreed, or had no opinion.

[1] Shaffer, J. D. (1957). "Who saves trading stamps?" Mich. Agr. Expt. Sta. Quart. Bul. 39(4): 583-586.

ARTICLE 41-21

Table 1 summarizes the responses to the four statements for the 1,884 homemakers who returned the mail questionnaire. Their responses indicated (1) that about 55 percent believed stores giving trading stamps usually have higher prices; (2) that about 53 percent believed that general practice of giving stamps increases the over-all cost of food; (3) that about 43 percent believed consumers benefit from the existence of trading stamp plans and (4) that only 22 percent believed trading stamps should be made illegal. It should be noted that those who did not hold these beliefs did not necessarily hold the opposite attitude since many expressed no opinion.

A number of homemakers (about 14 percent of the total) indicated

TABLE 1—Differences in reaction of 1884 consumers in four Michigan cities to statements about trading stamps

Statement	City	Percent of families who answered			Number of respondents
		Agree	Disagree	No opinion	
1. Stores giving trading stamps usually have higher prices than those not giving stamps (*a*)	Kalamazoo	62	31	7	508
	Muskegon	44	47	9	443
	Flint	61	26	13	414
	Grand Rapids	54	37	9	519
	Total mail	55	36	9	1,884
2. The general practice of giving stamps does not increase the over-all cost of food**	Kalamazoo	28	58	14	
	Muskegon	40	44	16	
	Flint	29	55	16	
	Grand Rapids	33	53	14	
	Total mail	32	53	15	
3. In general, consumers benefit from the existence of trading stamp plans(*a*)	Kalamazoo	40	43	17	
	Muskegon	53	28	19	
	Flint	30	46	24	
	Grand Rapids	49	36	15	
	Total mail	43	38	19	
4. Trading stamps should be made illegal(*a*)	Kalamazoo	25	46	29	
	Muskegon	18	55	27	
	Flint	25	36	39	
	Grand Rapids	18	55	27	
	Total mail	22	48	30	

(*a*) Responses were significantly different among the four cities at the .1 percent level.
** Responses were significantly different among the four cities at the 1 percent level.

a belief that stamp plans both increase food costs and benefit consumers. These homemakers apparently believed that while they must pay more for food as a result of stamps, the premiums they receive are worth more than the extra cost. However over 82 percent of those who indicated they believed stamp plans do not benefit consumers also believed that the practice of giving stamps increases the over-all cost of food. It is not unreasonable to assume that the beliefs concerning the effect of stamps on food prices were the primary basis for the conclusions concerning whether or not stamp plans benefit consumers.

The relationship between the responses to the third and fourth statements indicated two things. The first was that the belief of homemakers concerning the benefit of stamps was related to their attitude toward making stamps illegal. About 79 percent of those who believed stamps are beneficial to consumers would oppose making them illegal compared with 22 percent of those who believed stamps are not beneficial to consumers. The second observation is that a fairly large proportion of the homemakers did not accept the idea of government restriction of stamp plans even though they believed consumers did not benefit from the existence of such plans.

DIFFERENCES AMONG CITIES

Table 1 summarizes the reactions to the four statements about trading stamps according to the city. There was a significant difference in the responses among the four cities to each of the statements.

A larger proportion of the homemakers of Kalamazoo and Flint agreed with the first statement—stores giving stamps have higher prices—than was true in Muskegon or Grand Rapids. It may be that the experiences of consumers in these cities has been different and this accounts for the significant difference in attitudes between the cities. The difference among the cities was not as large in response to the second statement but followed the same pattern established by the first statement. In response to the third statement almost twice as many Muskegon families indicated a belief that consumers benefit from stamps as was true of homemakers in Flint. In response to the fourth statement homemakers of Muskegon and Grand Rapids replied in the same way with over 55 percent in each city disagreeing with the statement that stamps should be made illegal. The homemakers of

Flint, who had shown a consistently negative attitude toward stamps, were not sure what to do about it. Almost 40 percent expressed no opinion in response to this statement.

Nature of the Non-Response Bias

The information of the previous section is based upon replies to a mail questionnaire. Would the results have been substantially different if the data had represented all families rather than the 50 percent who answered the mail questionnaire? In order to get some idea of the answer to this question, approximately 75 percent of the non-respondents in Kalamazoo were interviewed in person. A comparison of the mail and personal interview responses for Kalamazoo indicated that the responses were significantly different for the first two statements and were not significantly different for the last two statements.[2]

If it is assumed that the mail and personal interview each represent half of the families in Kalamazoo, then an average of the results from each should represent the population as a whole within the sampling error.

Table 2 shows the percent of families giving each response to the four statements; for those responding by mail, those who were interviewed in person and the average of the two. In addition, two standard errors of the percent are shown for the mail response. This means, for example, that the chances are about 5 out of 100 that the true percent agreeing to the first statement lies beyond the range of 58 to 66 percent due to sampling error. This range includes the estimate based upon the average of mail and personal interview results. Actually in every case but one, the average of the mail and personal interview results fell within the range of the two standard errors of the estimated percent obtained by mail survey.

The nature of the bias was consistent. In every case the personal interview resulted in a larger percent of families giving no opinion and a smaller percent indicating a negative attitude toward trading stamps. Some of this difference might have been due to the difference in the nature of the interviewing method rather than a difference in actual opinions between the people returning the mail questionnaire and those who were interviewed. The mail questionnaire gives the respondent time to think and perhaps discuss the question with others in the family. This may provide some with a chance to form an

[2] Based upon Chi square tests and a 5 percent level of significance.

TABLE 2—Comparison of mail and personal interview results for Kalamazoo

	Percent of families who answered		
	Agree	Disagree	No opinion
Statement 1*			
Mail	62(±4)	31(±2)	7(±2)
Personal interview	53	31	16
Average	58	31	11
Statement 2*			
Mail	28(±4)	58(±4)	14(±3)
Personal interview	34	45	21
Average	31	52	17
Statement 3			
Mail	40(±4)	43(±4)	17(±3)
Personal interview	44	34	22
Average	42	39	19
Statement 4			
Mail	25(±4)	46(±4)	29(±4)
Personal interview	18	46	36
Average	22	46	32

*Responses were significantly different at the 5 percent level based upon Chi square test.

opinion who would not have the time when faced with the need to give an answer to a personal question.

Thus while the Chi square test indicated a statistically significant difference in the responses between the mail and personal interview (for the first two statements at least), it would appear that the bias is not of sufficient magnitude to significantly alter the findings based upon the mail survey.

Relationship of Opinions to Family Characteristics

An attempt was made to relate the attitude toward trading stamps to five characteristics of the family, size, income, food bill, and age and education of the homemaker. The data are presented in Tables 3-7. Since the tables and discussion that follows are in terms of the four statements, the statements are again listed below:

Statement 1 was, "Stores giving trading stamps usually have higher prices than those not giving stamps."

Statement 2 was, "The general practice of giving stamps does not increase the over-all cost of food."

Statement 3 was, "In general, consumers benefit from the existence of trading stamp plans."

Statement 4 was, "Trading stamps should be made illegal."

Size of family—(Table 3) The larger the family the more likely they were to agree to statement 1 and less likely they were to answer no opinion. The major difference in response to statement 2 was the smaller than average percent of the one-member families agreeing to the statement and the large percent of them answering no opinion. The larger the family the larger the percent disagreeing with statement 3 and the smaller percent answering no opinion. The only important difference in the response to statement 4 was the smaller than average percent of the one member families who disagreed and the larger number of them who answered no opinion.

TABLE 3—Differences in distribution of responses to statements about trading stamps among families of different sizes

Number in family	Percent of families who answered		
	Agree	Disagree	No opinion
Statement 1***			
1	44	36	20
2	50	40	10
3 or 4	58	35	7
5 or more	61	33	6
Statement 2***			
1	21	51	28
2	32	51	17
3 or 4	34	55	11
5 or more	35	55	10
Statement 3***			
1	41	24	35
2	45	35	20
3 or 4	45	40	15
5 or more	42	43	15
Statement 4**			
1	22	33	45
2	24	48	28
3 or 4	21	50	29
5 or more	21	51	28

** Responses were significantly different at the 1 percent level based upon Chi square test.
*** Responses were significantly different at the .1 percent level based upon Chi square test.

Family income—(Table 4) The distributions were significantly different among the three income groups for the first three statements only. In general, the higher the income group the larger the percent of families expressing a negative attitude toward trading stamps. However, this did not hold true for statement 4 where no significant difference in response was found among the income group. Thus, while a larger proportion of higher income families indicated opinions that stamp plans result in higher prices and do not benefit consumers than was true of the lower income families, the percent of families who would make trading stamps illegal did not differ among the income groups.

TABLE 4—Differences in distribution of responses to statements about trading stamps among families with different incomes

Level of disposable income	Percent of families who answered		
	Agree	Disagree	No opinion
Statement 1**			
Less than $4,000	50	39	11
$4,000 to $6,000	58	36	6
Over $6,000	61	31	8
Statement 2**			
Less than $4,000	36	46	18
$4,000 to $6,000	34	55	11
Over $6,000	28	61	10
Statement 3**			
Less than $4,000	48	31	21
$4,000 to $6,000	43	40	17
Over $6,000	38	48	14
Statement 4			
Less than $4,000	22	49	29
$4,000 to $6,000	21	51	28
Over $6,000	24	46	30

**Responses were significantly different at the 1 percent level based upon Chi square test.

Size of food bill—(Table 5) A significant difference in the pattern of responses was indicated among families with different sizes of food bills for each of the statements. The most obvious difference was the larger than average percent of the families with small food bills who expressed no opinion on each of the questions. In general (at least for the first 3 statements), those with larger food bills showed a higher propensity to express a negative opinion concerning the costs and benefits of trading stamps than those with smaller food bills.

TABLE 5—Differences in distribution of responses to statements about trading stamps among families with different sizes of food bills

Size of food bill	Percent of families who answered		
	Agreed	Disagree	No opinion
Statement 1***			
$10.00 or less	45	31	24
10.01—20.00	54	39	7
20.01—30.00	57	37	6
Over $30.00	63	31	6
Statement 2***			
$10.00 or less	28	42	30
10.01—20.00	34	53	13
20.01—30.00	35	55	10
Over $30.00	30	59	12
Statement 3***			
$10.00 or less	36	24	40
10.01—20.00	48	36	16
20.01—30.00	43	40	17
Over $30.00	42	47	11
Statement 4*			
$10.00 or less	22	34	44
10.01—20.00	20	51	29
20.01—30.00	21	51	28
Over $30.00	27	47	26

* Responses were significantly different at the 5 percent level based upon Chi square test.
*** Responses were significantly different at the .1 percent level based upon Chi square test.

Age of homemaker—(Table 6) A significant difference was indicated for each statement when related to the age of the homemaker. The distributions, however, did not show a clear cut pattern. Though a larger proportion of the younger homemakers were of the opinion that stamps increased costs and did not benefit consumers, fewer of them were in favor of making stamps illegal than was true of the homemakers over 45 years old.

TABLE 6—Differences in distribution of responses to statements about trading stamps among families with homemakers of different ages

Age of homemaker	Percent of families who answered		
	Agree	Disagree	No opinion
Statement 1***			
30 or less	63	30	7
31—45	63	33	7
46—60	50	41	8
Over 60	43	41	16
Statement 2***			
30 or less	37	53	10
31—45	30	59	11
46—60	33	51	16
Over 60	32	47	21
Statement 3***			
30 or less	47	39	14
31—45	40	43	17
46—60	47	36	17
Over 60	43	31	26
Statement 4*			
30 or less	15	57	28
31—45	21	49	30
46—60	25	45	30
Over 60	26	43	31

* Responses were significantly different at the 5 percent level based upon Chi square test.
*** Responses were significantly different at the .1 percent level based upon Chi square test.

Education of the homemaker—(Table 7) In general, the higher the level of education of the homemaker the more likely she was to have an opinion indicating that stamps increase food costs and do not benefit consumers. However, even with these views there was no significant difference in the attitude toward making trading stamps illegal among the homemakers of different levels of education.

TABLE 7—Differences in distribution of responses to statements about trading stamps among families with homemakers of different levels of formal education

Years of formal education	Percent of families who answered		
	Agree	Disagree	No opinion
Statement 1*			
0— 8	47	41	12
9—11	52	41	7
12—13	59	34	7
14 or more	61	32	7
Statement 2***			
0— 8	41	42	17
9—11	36	50	14
12—13	34	54	12
14 or more	25	64	11
Statement 3***			
0— 8	52	28	20
9—11	49	33	18
12—13	42	40	18
14 or more	38	48	14
Statement 4			
0— 8	23	51	26
9—11	20	50	30
12—13	22	49	29
14 or more	23	47	30

* Responses were significantly different at the 5 percent level based upon Chi square test.
*** Responses were significantly different at the .1 percent level based upon Chi square test.

SUMMARY

1. This study was based upon a mail survey of 4,000 homemakers in Kalamazoo, Muskegon, Flint, and Grand Rapids. About 50 percent of the 4,000 questionnaires were returned. The questions pertaining to trading stamps were in the form of four statements which the respondents were asked to check if they agreed, disagreed, or had no opinion.

2. The first statement was, "Stores giving trading stamps usually have higher prices than those not giving stamps," to which 55 percent agreed, 36 percent disagreed, and 9 percent responded with "no opinion."

3. The second statement was, "The general practice of giving stamps

does not increase the over-all cost of food," to which 32 percent agreed, 53 percent disagreed, and 15 percent checked no opinion.

4. The third statement was, "In general consumers benefit from the existence of trading stamp plans." In response to this statement 43 percent indicated they agreed, 38 percent disagreed, and 19 percent had no opinion.

5. The fourth statement was, "Trading stamps should be made illegal." About 22 percent agreed, 48 percent disagreed, and 30 percent indicated they had no opinion.

6. Less than half of the consumers who indicated a belief that stamp plans do not benefit consumers indicated that trading stamps should be illegal.

7. There was a significant difference in the pattern of responses among the four cities. Kalamazoo and Flint consistently showed a more negative attitude toward stamps than the other two cities. Kalamazoo consumers expressed a more negative attitude toward stamps than Flint. Muskegon and Grand Rapids consumers expressed opinions more favorable to stamps with the homemakers of Muskegon most favorably inclined.

8. A personal interview survey of the non-respondents in Kalamazoo was made in order to estimate the nature of the non-response bias. For each of the four statements the personal interview indicated a larger percent of families with no opinion and a smaller percent with a negative attitude toward trading stamps. The bias, however, does not appear to have been of such a magnitude as to significantly affect the results.

9. An attempt was made to determine something of the relationship betwen consumers' opinions and five family characteristics. Responses to the first three statements were found to be significantly related to size of family, family income, size of food bill, age of homemaker, and the level of formal education of the homemaker. The fourth statement did not show a significant relationship with income or education but did for the other three factors.

AN INSTRUMENT DESIGNED TO GIVE A RANGE OF SOIL COMPACTIONS FOR LABORATORY AND GREENHOUSE INVESTIGATIONS[1]

By GEORGE W. FRENCH and F. W. SNYDER[2]

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Compaction is one of the important factors influencing soil structure which may, directly or indirectly, affect plant growth. A method of producing a range of soil compactions would facilitate investigations concerning the effect of this factor on soil structure and plant growth.

Our pneumatic soil compaction instrument was designed to apply standardized degrees of compaction accurately and rapidly by increments of 1 or 2 pounds per square inch (p.s.i.). With a pressure foot having a surface area of 15 square inches, e.g. 3 by 5 inches, pressures up to about 50 p.s.i. are attainable. Pressures approximating 100 p.s.i. can be applied to cores of soil 3 inches in diameter.

Figs. 1 and 2 show the general construction of the instrument and arrangement of the controls. Fig. 3 is an air flow diagram. The components are mounted on the body of the pneumatic cylinder. This assembly unit is attached to the top frame truss by a pin through the yoke on the upper cylinder head. Lateral stability is provided by a loose-fitting ring in the frame cross-member at the lower end of the cylinder.

For use in field plots, the cylinder assembly unit can be readily removed from the frame of the instrument and attached to a suitable cantilever beam mounted on a tractor in such a manner that the weight of the tractor would resist the upward thrust of the cylinder.

The force applied to the soil is proportional to the pressure indicated by the gauge. The unit pressure is a function of the area of the

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piston, the air pressure, and the area of the pressure foot in contact with the soil. It may be expressed by the following equation:

$P_s = \frac{P_a \times A_p}{A_f}$ when P_s = pressure in p.s.i on the soil, P_a = air pressure

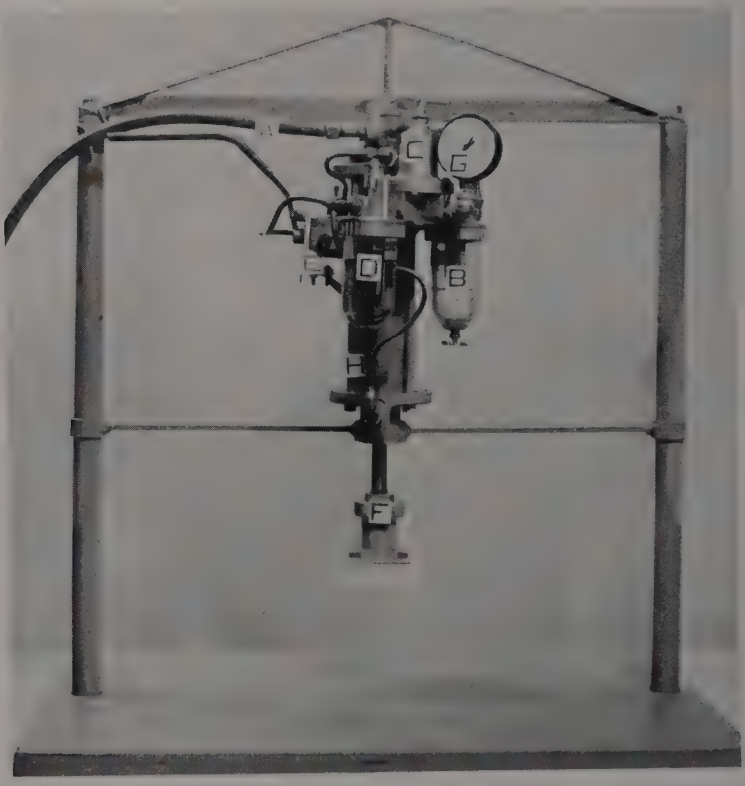

Fig. 1. Pneumatic soil compaction instrument. The structural members of this instrument are designed to withstand a piston thrust of 700 pounds. This thrust would be produced by 100 p.s.i. air pressure in the cylinder. The designated components are as follows:

A. Compressed air supply line.
B. Moisture trap.
C. Pressure regulator valve.
D. Lubricator.
E. Two-way control valve.
F. Pressure foot mounting.
G. Pressure gauge.
H. Double-acting, two-way cylinder.

Fig. 2. Pneumatic soil compaction instrument. Bottom view. Steel structural member opposes the bending stress applied to the platform by the thrust of the piston.

indicated by the gauge, A_p = area of piston, and A_f = area of pressure foot on the soil. For this particular instrument, the diameter of the piston is 3 inches and A_p is a constant equal to $(1.5)^2$ II, or 7.0686 square inches. For any given pressure foot used, $P_s = P_a K$, and $K = \frac{7.0686.}{A_f}$

In the above computation, no allowance was made for friction drag between the piston and the wall of the pneumatic cylinder. The reduction in force applied to the soil as a result of this friction is a variable and indeterminate quantity, so some provision for eliminating this error is necessary. The method used to minimize the effect of friction drag is to rotate the piston in the cylinder after the piston has come to a stop. The piston can be rotated manually without disturbing the contact betwen the pressure foot and the soil.

Fig. 4 shows the attachment of the pressure foot to the piston rod which permits the rotation. The performance of the instrument, described above, is illustrated in Table 1. The data were secured as follows:

1. The air pressure regulator was adjusted to produce the desired thrust as measured by a platform scale as shown in Fig. 5. When the adjustment was completed the gauge reading was recorded.
2. The piston was retracted and the force re-applied to the scale

A. Shut-off Valve
B Moisture Trap
C. Pressure Regulator
D. Lubricator
E. Two-way Control Valve
G. Air Pressure Gauge
H. Double Acting Two-way Cylinder

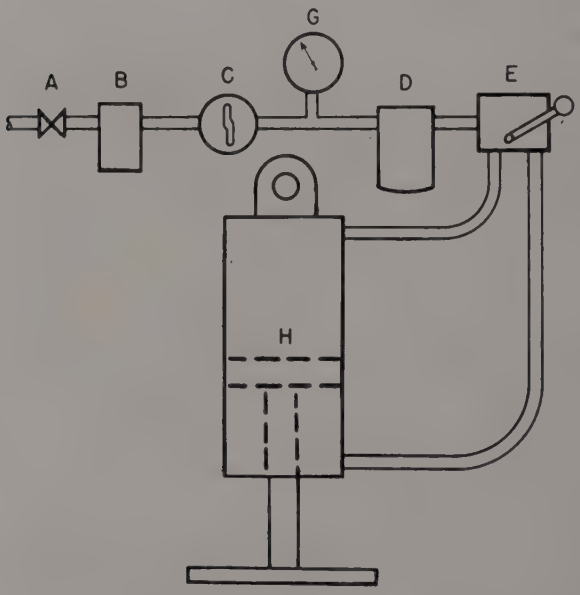

Fig. 3. Air flow diagram for pneumatic soil compaction instrument. Air admitted by valve (A) passes through moisture trap (B), pressure regulator valve (C), lubricator (D), two-way control valve (E), and to pneumatic cylinder (H). The air pressure can be admitted to the cylinder either above or below the piston by control valve E.

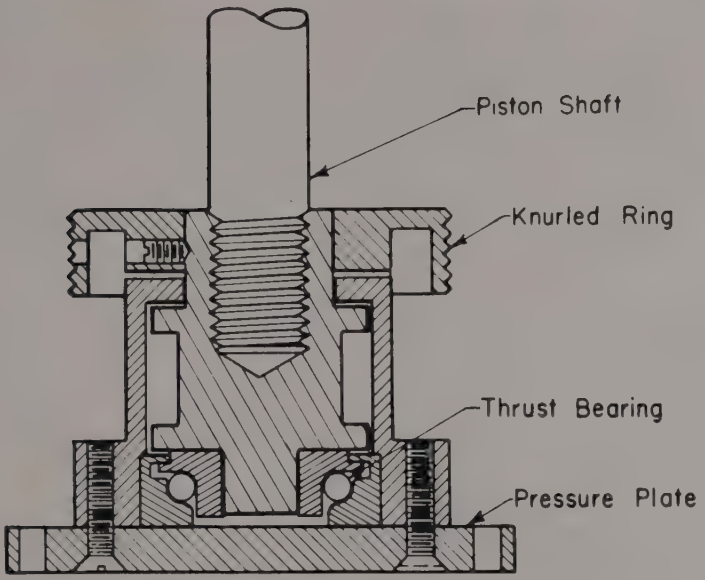

Fig. 4. Free turning mounting for pressure foot. See text.

TABLE 1—Data to illustrate the performance characteristics of the soil compaction instrument

Desired thrust (lb.)	Regulator valve setting	Gauge reading (p.s.i.)	Range of piston thrust(*a*)	
			Before rotation (lb.)	After rotation (lb.)
30	1A	4.3	25— 26	29— 32
30	1B	4.3	24— 28	31— 32
60	2A	8.4	51— 53	59— 60
60	2B	8.4	51— 56	60— 61
90	3A	12.8	82— 83	88— 90
90	3B	12.8	82— 84	90— 91
140	4A	19.7	131—132	137—139
140	4B	19.7	130—132	138—140
200	5A	28.3	192—194	201—202
200	5B	28.3	191—193	201—202
300	6A	42.7	290—291	298—300
300	6B	42.7	290—291	299—300

(*a*) Four determinations were made with each regulator valve setting. The highest and lowest values are recorded.

four times with each regulator valve setting. The maximum and minimum thrusts were recorded in Table 1.

3. The first series (A) of six progressively increasing thrusts may be considered as calibration of the gauge used in terms of piston thrust. In the second series (B), the regulator valve was adjusted to reproduce the gauge readings associated with each of the settings in the first series (A). The piston thrust was then applied to the scale four times.

Table 1 shows that the degree of error to be expected is quite moderate. The absolute error with 30 to 300 pounds thrust (after the piston is rotated) is within the range of +2 to −3 pounds. The percentage of error ranges from 6.7 percent with a nominal thrust of 30 pounds down to 0.7 percent with a thrust of 300 pounds. Before rotating the piston, friction drag reduced the applied thrust force by 4 to 11 pounds within the range of thrust forces measured, e.g. 30 to 300 pounds. However, when the piston was rotated as prescribed, the force applied could be repeated with deviations not to exceed 3 pounds by resetting to the same indicated gauge pressure.

The instrument performs sluggishly when a force of less than 30 pounds is required. When low pressures are desired, the force may be obtained by lowering the pressure foot to contact the soil and manually pushing down on the foot until a weighing scale indicates the correct force has been applied. This instrument is not recommended for field work involving thrust forces of less than 30 pounds. When very low compaction pressures are desired, a larger pressure foot may be used to insure thrust forces in excess of this lower limit.

When the instrument is used in the field or for compacting soil in large containers, the pressures applied must be determined by the gauge reading. If a calibration chart for the particular gauge used is made according to the procedure employed in securing the data for Table 1, a high degree of accuracy can be expected. In the laboratory when using small containers of soil (10 pounds or less), Stout et al. and Stout and Snyder[3] preferred to place the container on a bathroom scale to measure the force applied to the soil (Fig. 5). Stout found this procedure rapid and accurate, especially for the lower compaction pressures.

[3]Stout, B. A.; F. W. Snyder, and W. M. Carleton (1956). The effect of soil moisture and compaction on sugar beet emergence. Jour. Amer. Soc. Sugar Beet Tech. 9(3): 277-283. Also, Stout, B. A., and F. W. Snyder (1957). Soil compaction for optimum sugar beet seedling emergence, as influenced by soil moisture, depth of planting, and aggregate size. Proc. Ninth Reg. Meeting Amer. Soc. Sugar Beet Tech.: 106-114.

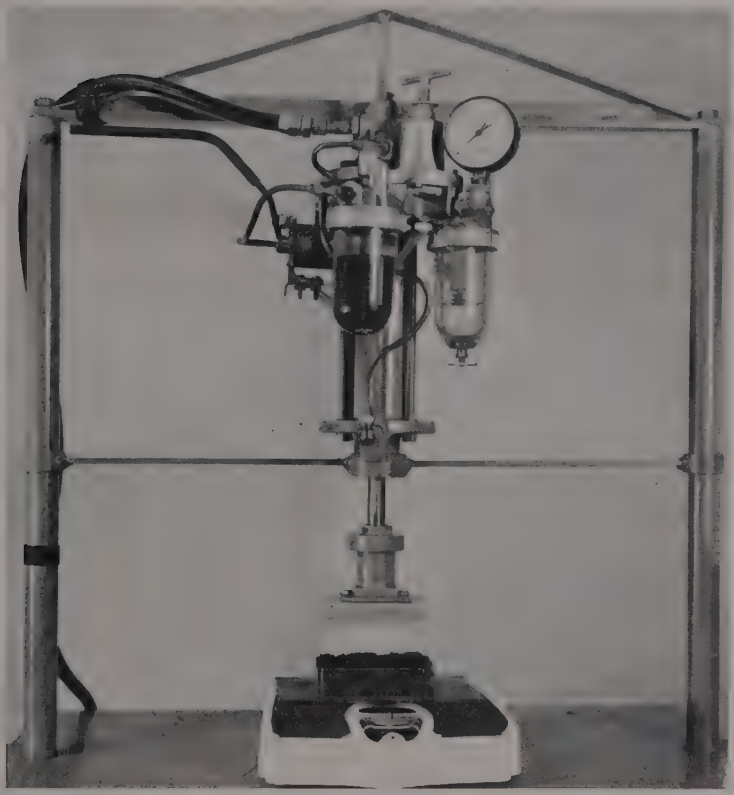

Fig. 5. Bathroom scale used to measure force applied to the surface of small containers of soil. (From Stout et al., 1956.)

In the operation of this instrument, using a standard procedure gave more uniform results. The rate of lowering the pressure foot affects the amount of impact against the soil. In compaction studies, the pressure foot should be lowered gently. To insure more uniform final thrust forces, the arm of the operator should be held perpendicular to the shaft of the piston when rotating it.

DISCUSSION

The general availability of air compressors or compressed air cylinders would permit the use of this instrument under a great variety of experimental conditions.

This compaction instrument has performed satisfactorily for the

three specific uses cited. Stout et al. and Stout and Snyder[4] have used it in a study of the effect of soil compaction, soil moisture, and depth of planting on emergence of sugar beet seedlings. By employing a circular plunger, Willits[5] has used the compactor to study the effect of pressure on the change in bulk density of undisturbed soil core samples and to study the relationship between soil bulk density and the number of times the soil is compacted.

SUMMARY

A pneumatic soil compaction instrument, designed to give reproducible compaction pressures by increments of 1 or 2 p.s.i. is described. With a pressure foot of 15 square inches, pressume up to 50 p.s.i. are attainable. Pressures approximating 100 p.s.i. can be applied to cores of soil 3 inches in diameter. Three specific uses of this instrument are cited.

[4]Stout et al. (1956) and Stout and Snyder (1957) op. cit.

[5]Willits, N. A. (1956). Measurement of pressures in soils produced by traffic and the relationship between those pressures and compaction in undisturbed soils. Doctoral dissertation, Michigan State University, East Lansing. 100 pp.

SUGAR BEET-TOP SILAGE FOR DAIRY COWS

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MICHIGAN FARMERS GROW ABOUT 70,000 acres of sugar beets annually. Each acre yields about 12 tons of roots and about 700 to 800 pounds of tops per ton of roots. The newer types of harvesting equipment remove the beet tops before the roots are dug; the tops do not include crowns. Previously, the beets were dug and then the tops and crowns were removed. Beet tops harvested in this manner usually contained considerable dirt which affect their feeding value.

The value of beet-top silage for milking cows has been investigated previously, but the silage was made from soiled tops. Eckles (1930) reported that beet-top silage was inferior and unpalatable to dairy cows. It had a bad odor and much of it was not usable. There was also considerable leakage from the silo which indicated that the moisture content was too high for good results. When the tops were wilted before ensiling, a satisfactory silage could be made. Also, when 20 percent by weight of dry chopped corn fodder was mixed with the tops, good silage resulted.

Steensberg (1950) found that good beet-top silage could be made, depending on the moisture content and the amount of dirt and sand. Steensberg (1933) emphasized the importance of using clean beet tops for ensiling. In beet-top silage free from dirt, the coefficients of digestibility of protein and organic matter were 70 and 74 percent, whereas that from soiled tops were 61 and 64 percent, respectively. Silage made from clean beet tops makes a valuable feed for dairy cattle.

According to Jarl (1948), the digestibility of the organic matter drops as the ash content of the dry matter rises. The feeding value for dairy cows varied with the digestibility of the organic matter.

Richter and Becker (1955) compared beet-top silage and corn silage

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using two milking cows. Each cow consumed 99 pounds of beet-top silage daily. It was more acceptable than the corn silage.

There are limited data available in the literature on the value of beet-top silage for milk production. The purpose of this study was to determine the feeding value of silage made from sugar beet tops which had been harvested with a new type of equipment.

TRIAL I

Sugar beet tops harvested with the new equipment were ensiled on the Detroit State Farm near Merrill, Michigan. Two hundred pounds of dried beet pulp were added per ton of freshly cut material. Some of this silage was delivered to the dairy department of Michigan State University and stored in an upright silo.

This material was used in digestion trials with four cows and also in trials with milking cows. Coefficients of digestibility were determined on the silage alone. A very good second-cutting alfalfa harvested in the bud stage was used in the feeding trials with the beet-top silage in the milk production studies.

The grain mixture used in these studies was as follows: ground shell corn, 880 pounds; soybean oil meal, 100 pounds; salt, 10 pounds; and dicalcium phosphate, 10 pounds. The estimated crude protein and total digestible nutrient content (T.D.N.) of the grain mixture were 12.4 and 78.4 percent, respectively.

Three pairs of cows were used to study the effect on milk production when part of the dry matter in the silage was replaced with grain. Also, six cows were fed good second-cutting alfalfa hay alone for eighteen days and then 12.4 pounds of hay was replaced by 50 pounds of beet-top silage.

RESULTS OF TRIAL I

The quality of the silage was excellent from the standpoint of aroma, and a pH of 4 indicated good fermentation.

The chemical composition and digestion coefficients of the beet-top silage, which had been preserved with about 200 pounds of sugar beet pulp per ton of green material, are shown in Table 1.

The silage also contained 76 p.p.m. of carotene on the dry basis. The percent of mineral constituents on the dry basis were: potassium, 2.8; calcium, 1.3; phosphorus, .21; magnesium, .8; iron, .084; copper, .0019; manganese, .010; and cobalt, 28 p.p.m.

TABLE 1—Chemical composition, coefficients of digestibility, digestible protein, and total digestible nutrient content of roughage used in Trials I and II

	Dry matter	Organic matter	Crude protein	Ether extract	Crude fiber	N.F.E.	Ash	Digest. protein	T.D.N.
	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)	(percent)
Beet-top silage(*a*)									
(1955 crop, wet)...	21.6	18.4	3.5	0.85	3.5	10.5	3.2	2.3	12.7
(1955 crop, dry)...	100.0	85.2	16.2	3.9	16.2	48.6	14.8	10.6	58.8
Beet tops									
(1957 crop, wet)...	13.9	12.0	2.9	0.23	1.9	7.0	1.9	....	....
(1957 crop, dry)...	100.0	86.3	20.9	1.7	13.7	50.4	13.7	....	....
Beet-top silage(*a*)									
(1957 crop, wet)...	21.3	19.3	3.5	0.27	3.6	11.9	2.0	....	....
(1957 crop, dry)...	100.0	90.6	16.4	1.3	16.9	55.9	9.4	8.9(*b*)	62.6(*b*)
Alfalfa hay									
(cut early).....	84.5	79.4	14.2	1.22	32.4	31.5	5.1	....	....
(cut late).....	83.2	79.0	9.9	0.59	40.2	28.2	4.2	....	....
(bud stage).....	87.0	80.0	17.6	2.20	20.2	40.0	7.0	13.0	56.7
Coefficients of digestion.....	67	71	74	54	53	75	....	....	....
Coefficients of digestion obtained for 1955 beet-top silage									
Cow T 20.....	64.1	68.5	54.2	43.1	67.5	74.1	....	....	....
Cow T 3.....	66.3	79.9	59.0	41.2	70.3	73.9	....	....	....
Cow T 19.....	63.4	67.4	53.3	41.1	71.8	72.6	....	....	....
Cow A 103.....	61.7	65.6	52.8	39.2	70.3	70.4	....	....	....
Average.....	63.9	70.4	54.8	41.2	70.0	72.8	....	....	....

(*a*) Preserved with 200 lb. of dry beet pulp per ton.
(*b*) Used coefficients obtained for 1955 beet-top silage to calculate these values.

TABLE 2—Comparison of beet-top silage for milk production with and without grain (Trial I)

Ration	Days in milk	Body weight	F.C.M.	Average daily intake per cow			
				Hay	Silage	Grain	T.D.N.
		(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)
Beet-top silage with grain (6 cows)							
Hay, (basal).....	76	1003	33.1	24.3	..	8.2	18.8
Hay+silage.....	76	1008	33.7	24.3	35	1.8	18.2
Beet-top silage with 2nd cutting alfalfa hay (6 cows)							
Hay, (basal).....	242	1116	12.0	24.9	..	..	12.7
Hay+silage.....	263	1110	12.0	12.5	50	..	12.7

The results obtained on milk production in Trial I are summarized in Table 2. When 35 pounds of silage replaced 6.4 pounds of grain, the average body weights and F.C.M. (4 percent fat-corrected milk) remained about the same which indicated that the T.D.N. in the silage had about the same milk-producing value as the T.D.N. in grain.

In the comparison of beet-top silage with second-cutting alfalfa hay, the average F.C.M. was the same for hay and silage as for the hay alone. However, in four of the six trials, F.C.M. increased when 50 pounds of silage replaced the hay on a T.D.N. basis. The two cows that did not increase in milk production were in advanced lactation and were about dry.

The results of the trials with milking cows indicated that beet-top silage is a valuable feed, but that further data were needed.

TRIAL II

In the fall of 1957, about 50 tons of sugar beet tops harvested by the new method were obtained from the Baldwin Farm at Stockbridge, Michigan, and placed in an upright silo at the dairy experimental barn. About 200 pounds of dried beet pulp per ton of beet tops were placed on each load. This mixture was blown into the silo. Some separation of the beet pulp from the beet tops occurred during the blowing process.

The silo was opened about 6 weeks after the beet tops had been ensiled. There was some seepage, but not an excessive amount. Two groups of eight cows each were used in a reversal design experiment to study the milk-producing value of the beet-top silage.

Some of the higher milk-producing cows in both groups were fed grain (the same mixture as was fed in Trial I). Two kinds of hay were fed in equal amounts. One hay was early-cut and the other was late-cut alfalfa; both were first-cutting hays.

Group 1 was fed the hay ration, then the beet-top silage ration, and back to the hay ration, while Group 2 was fed the silage ration, then the hay ration, and back to the silage ration. Each period was 24 days in length. No adjustment was made in the rations to compensate for changes in milk production. All of the milk was tested for butterfat by 3-day periods. The cows were weighed for 3 consecutive days at the beginning and end of each period.

In assembling the data, the first 6 days of each period were considered as the transitional period and only the last 18 days of each period were used.

RESULTS AND DISCUSSION

The chemical composition of the roughages used in both experiments are shown in Table 1. A comparison of the 1955 and 1957 beet-top silages preserved with about 200 pounds of beet pulp per ton of fresh material shows similar dry matter, protein, and crude fiber contents. The ether extract and ash values for the 1957 silage were lower, and the organic matter and N.F.E. were higher than those obtained for the 1955 silage. Considerable difficulty was encountered in obtaining a representative sample of the 1957 silage for chemical analysis because of the separation that occurred when the beet tops and beet pulp were blown into the silo.

The composition of the beet tops, on the dry basis, just prior to ensiling the 1957 crop, is also shown in Table 1. The percentages of protein, crude fiber, N.F.E., and ash were 20.9, 13.7, 50.4, and 13.7,

TABLE 3—The effect of replacing a part of the hay with beet-top silage on body weight and milk production (7-24 days, Trial II)

GROUP 1

Period	Cow	Weight			Milk	Test	F.C.M.	Average daily intake		
		Start	End	Change				Hay	Grain	Silage
		(lb.)	(lb.)	(lb.)	(lb.)	(percent)	(lb.)	(lb.)	(lb.)	(lb.)
1	T68	915	945	30	25.5	3.8	24.7	28	4.0	..
1	T67	1013	1011	−2	28.5	3.9	34.6	27	5.2	..
1	T66	910	911	1	18.8	3.8	18.2	27	1.0	..
1	A77	1174	1236	62	19.1	3.5	17.7	27	1.4	..
1	T15	1313	1329	16	42.2	3.1	36.5	28	12.2	..
1	A115	933	908	−25	17.6	3.6	16.5	27	...	..
1	K302	973	1027	54	17.5	3.8	17.0	28	...	..
1	A76	1172	1204	32	16.4	4.2	16.9	28	1.4	..
Average...	.....	1050	1071	21	23.2	3.7	22.8	27.5	3.2	..
2	T68	945	907	−38	33.0	4.2	34.0	5	4.0	86
2	T67	1010	929	−81	36.8	4.0	36.8	5	5.2	86
2	T66	911	883	−28	26.4	3.8	25.6	6	1.0	85
2	A77	1236	1217	−19	24.6	3.4	22.4	6	1.4	83
2	T15	1329	1315	−14	36.9	3.2	32.5	6	12.2	86
2	A115	908	894	−14	24.4	3.5	22.6	6	...	84
2	K302	1027	972	−55	23.7	3.8	23.0	6	...	86
2	A76	1204	1179	−25	25.8	4.2	26.6	6	1.4	86
Average...	.....	1071	1037	−34	29.0	3.8	27.9	5.8	3.2	85
3	T68	907	928	21	26.3	3.9	25.9	28	4.0	..
3	T67	929	976	47	29.6	3.8	28.7	28	5.2	..
3	T66	883	914	31	19.6	4.0	19.6	28	1.0	..
3	A77	1217	1291	74	9.8	4.2	10.1	28	1.4	..
3	T15	1315	1325	10	31.3	3.0	26.6	28	12.2	..
3	A115	894	952	58	16.5	3.8	16.0	28	...	..
3	K302	972	1028	56	16.6	4.1	16.8	28	...	..
3	A76	1179	1214	35	17.9	4.2	18.4	28	1.4	..
Average...	.....	1037	1079	42	21.0	3.9	20.3	28.0	3.2	..

respectively, compared with 13.8, 19.5, 39.0, and 25.3, respectively, as reported by Schneider (1947) for silage made from washed crowns and tops.

The feed consumption data are summarized in Table 5. The cows were fed 3.4 pounds of grain per day on the hay ration and 3.6 pounds on the beet-top silage ration. The cows consumed 27.8 pounds of hay during the hay ration and 5.9 pounds daily during the silage ration. The silage cows were fed 86 pounds of silage per cow per day, and the average daily consumption was 85 pounds. Most of the silage weighbacks may have been due to the feeding of lower quality silage near the top of the silo since the cows in Group 2 averaged 84 pounds of silage during Period 1 and 86 pounds during Period 3 (near bottom of silo, Table 4).

TABLE 4—The effect of replacing hay with beet-top silage on body weight and milk production (7-24 days, Trial II)

GROUP 2

Period	Cow	Weight			Milk	Test	F.C.M.	Average daily intake		
		Start	End	Change				Hay	Grain	Silage
		(lb.)	(lb.)	(lb.)	(lb.)	(percent)	(lb.)	(lb.)	(lb.)	(lb.)
1	CS-205	958	956	−2	20.9	3.1	18.1	6	...	81
1	CS-203	843	833	−8	23.0	3.2	20.2	6	...	84
1	K-239	1033	979	−54	32.2	3.4	29.3	6	1.6	85
1	A-110	1089	1119	36	40.3	3.4	36.7	6	6.2	85
1	A-118	824	818	−6	25.2	3.4	22.9	6	...	82
1	A- 80	1277	1254	−23	28.4	3.8	27.5	6	5.0	86
1	K-218	1056	1045	−11	32.9	3.8	31.9	6	4.0	86
1	A-103	1203	1178	−25	47.9	3.8	46.5	5	13.6	80
Average...	.....	1035	1023	−12	31.4	3.5	29.1	5.9	3.8	84
2	CS-205	956	1007	51	16.3	3.4	14.8	28	...	..
2	CS-203	835	902	67	17.0	3.6	16.0	28	...	..
2	K-239	979	1095	116	25.9	3.8	25.1	28	1.6	..
2	A-110	1119	1216	97	31.0	3.5	28.7	28	6.2	..
2	A-118	818	869	51	15.8	3.7	15.1	28	...	..
2	A- 80	1254	1350	96	24.2	4.0	24.2	28	5.0	..
2	K-218	1045	1125	80	27.4	4.1	27.8	28	4.0	..
2	A-103	1178	1260	82	42.2	4.0	42.2	27	13.6	..
Average...	.....	1023	1103	80	25.0	3.8	24.2	27.9	3.8	..
3	CS-205	1007	1030	23	21.9	3.2	19.3	6	...	86
3	CS-203	902	935	33	24.9	3.5	23.0	6	...	86
3	K-239	1095	1043	−52	34.2	3.5	31.6	6	1.6	86
3	A-110	1216	1200	−16	40.1	3.6	37.7	6	6.2	86
3	A-118	869	869	0	25.4	3.8	24.6	6	...	86
3	A- 80	1350	1360	10	29.4	3.9	29.0	6	5.0	86
3	K-218	1125	1129	4	34.9	4.0	34.9	6	4.0	86
3	A-103	1260	1262	2	43.7	3.8	42.4	6	13.6	86
Average...	.....	1103	1104	0	31.8	3.7	30.3	6.0	3.8	86

TABLE 5—Summary of milk production, body weight and feed intake (Trial II)

	Average 7-24 days	
	Hay	Beet-top silage
Milk production (lb. per cow per day)		
Milk (actual)(*a*)	23.1	30.8
Butterfat test (percent)	3.8	3.7
4 percent F.C.M.(*a*)	22.4	29.1
Body weight change (lb. per cow)(*a*)	47.4	−16.2
Feed consumption (lb. per cow per day)		
Grain	3.4	3.6
Hay	27.8	5.9
Hay dry matter	23.3	4.9
Beet-top silage	....	85.0
Silage dry matter	....	18.1
Total hay and silage dry matter	23.2	23.0

(*a*) Significant difference.

The cows consumed 23.3 pounds of roughage dry matter daily on the hay ration and 23.0 pounds on the silage ration. It is obvious that the cows consumed more T.D.N. when fed the silage ration than when fed the hay ration, since the estimated T.D.N. content (Table 1) of the silage was 62.6 on the dry basis.

Milk production, body weights, and the feed consumption of the individual cows used in Groups 1 and 2 are shown in Tables 3 and 4, respectively. The cows in Group 1 were started on the hay ration and then were changed to 86 pounds beet-top silage in place of 21.7 pounds of hay. The amount of F.C.M. increased in Period 2 from 22.8 to 27.9 pounds and then decreased in Period 3 to 20.3 pounds per day. After the cows in Group 2 were changed from the silage ration to the hay ration in Period 2, the amount of F.C.M. decreased from 29.1 to 24.2 pounds daily and then increased to 30.3 pounds when changed back to the silage ration. As shown in Table 5, the cows on the hay ration averaged 6.7 pounds less F.C.M. than those on beet-top silage.

Contrary to popular opinion, the heavy feeding of beet-top silage preserved with 200 pounds of sugar beet pulp per ton of tops did not result in an off-flavor in the milk when the silage was fed after milking (Jensen *et al.*, 1958).

No significant difference was found between the two rations in the percentage of butterfat.

The cows in Group 1 lost weight during the silage period and gained weight when changed back to the hay ration (two cows lost weight on hay ration). The cows in Group 2 gained weight on the hay ration (Period 2), and all but one cow lost weight during Period 1 when receiving silage. In Period 3, however, only two cows lost weight on the silage ration. As shown in Table 5, the cows lost an average of 16.2 pounds of weight on silage and gained 47.4 pounds on the hay ration. Although the difference is statistically significant, it may have been due to a difference in digestive tract fill. This is more likely in view of the softness of the feces during the beet-top silage feeding periods. The feces of the cows fed silage had a consistency similar to the feces of cows on young succulent pasture.

SUMMARY

The feeding value of silage made from sugar beet tops harvested with a forage harvester and ensiled with 200 pounds of beet pulp per ton of tops was investigated in two experiments. In Experiment I, milk production was maintained when 35 pounds of beet-top silage replaced 6.4 pounds of grain in an all-hay ration. This indicated that the T.D.N. in the beet-top silage and grain were about equal for milk production. When 50 pounds of silage replaced 12.4 pounds of good second cutting alfalfa hay, four of six cows increased in F.C.M.

The percentage composition of the 1957 beet tops on the dry matter basis were: protein, 20.9; ether extract, 1.7; crude fiber, 13.7; N.F.E., 50.4; and ash, 13.7.

In the second trial, two groups of 8 cows each were fed on a reversal design experiment to determine the effect of replacing 22 pounds of hay with 85 pounds of beet-top silage daily. The first 6 days of each 24-day period were not used in calculating the results. The cows averaged 22.4 and 29.1 pounds of F.C.M. per day on the basal and beet top rations, respectively. The cows gained 47.4 pounds in body weight on the basal ration and lost 16.2 pounds on the beet-top silage ration. Some of the loss in weight on silage may have been due to less digestive tract fill.

The flavor of the milk produced by cows fed beet-top silage was very good when the silage was fed after milking.

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A RAPID CHEMICAL DETERMINATION OF THE MAGNESIUM CARBONATE CONTENT OF MARL COUPLED WITH A SURVEY OF THIS MATERIAL IN MICHIGAN MARL DEPOSITS

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THE WIDE USE OF MARL in Michigan as a liming material made it desirable to have a rapid method for the determination of its magnesium carbonate content. A study was initiated to develop or modify an existing chemical procedure for the rapid determination of magnesium carbonate in marl, and to evaluate marl as a source of magnesium carbonate.

Both calcium and magnesium have long been known as essential nutrient elements for plant growth. However, the needed amounts of exchangeable soil calcium and magnesium for optimum plant growth have been somewhat controversial. Some workers (Kellogg, 1931, and Truog, 1931) have reported that it is essential to maintain a proper balance between soil calcium and magnesium for efficient utilization of phosphorus. Others (Lipman, 1916, and Moser, 1933) have stated that there is no specific optimum Ca to Mg ratio in the soil.

Recent work by Prince et al. (1947) has shown the most important single factor influencing the magnesium uptake of plants is the quantity of potassium available; when an abundance of potassium was available to the plant, the content of magnesium was relatively low. The response of plants to magnesium additions is governed in part by its ratio to the other cations on the exchange complex, especially calcium and potassium.

Chemical Determination of Magnesium Carbonate in Marl

The procedure used was essentially the method proposed by Drosdoff and Nearpass (1948) for the determination of magnesium in plant

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tissue and soil extracts. This method employs thiazole yellow (sodium 2, 2 disulfonate of methylbenzolthiazole) which has been reported (Mikkelsen and Toth, 1947) as the most selective for magnesium of over 130 organic compounds tested.

A 0.5-gm. sample of marl was weighed and placed in a 250 ml. Erlenmeyer flask containing 2 ml. of concentrated nitric acid and 20 ml. of distilled water and evaporated to dryness. The residue was dissolved in distilled water; ¼ teaspoon of Darco-G-60 (activated carbon) was added and thoroughly mixed to clarify the solution. The material was then filtered into a 500 ml. volumetric flask. The filter paper was rinsed several times with distilled water.

The sample was made to volume with distilled water and a 5-ml. aliquot of the sample was transferred to one of a set of matched colorimeter tubes and the color developed (Drosdoff and Nearpass, 1948). The pH of the sample after the addition of 0.5 ml. of 10 percent sodium hydroxide solution was about 12.3. This appeared to be the optimum pH for maximum color development.

All measurements were carried out on a Baush and Lomb Spectronic 20 colorimeter at a wavelength of 540 millimicrons.

Preparation of the Calibration Curve

A stock solution containing 2 mg. of magnesium carbonate per milliliter was prepared. Aliquots of the stock solution were transferred to Erlenmeyer flasks to give standard solutions corresponding to 1, 2, 3, 4, and 5 percent $MgCO_3$. Two milliliters of concentrated nitric acid and 0.4 gm. of precipitated calcium carbonate were added and the solution was evaporated to dryness on a hot plate. The residue was dissolved in distilled water and ¼ teaspoon of Darco-G-60 was added, thoroughly mixed, filtered, and made to volume with distilled water.

The color was developed in a 5-ml. aliquot of the standard solution using the same procedure employed for the sample. A calibration curve was constructed using a water blank and plotting the percent transmittance versus percent magnesium carbonate as shown in Fig. 1.

A comparison of the percent elemental magnesium obtained in two marl samples by the procedure employing thiazol yellow and two gravimetric procedures is shown in Table 1. Close agreement existed between the colorimetric and gravimetric procedures. The differences obtained in elemental magnesium between the colorimetric procedure and method number 1 for samples A and B were .057 and .086 percent, respectively. The differences obtained between the colorimetric pro-

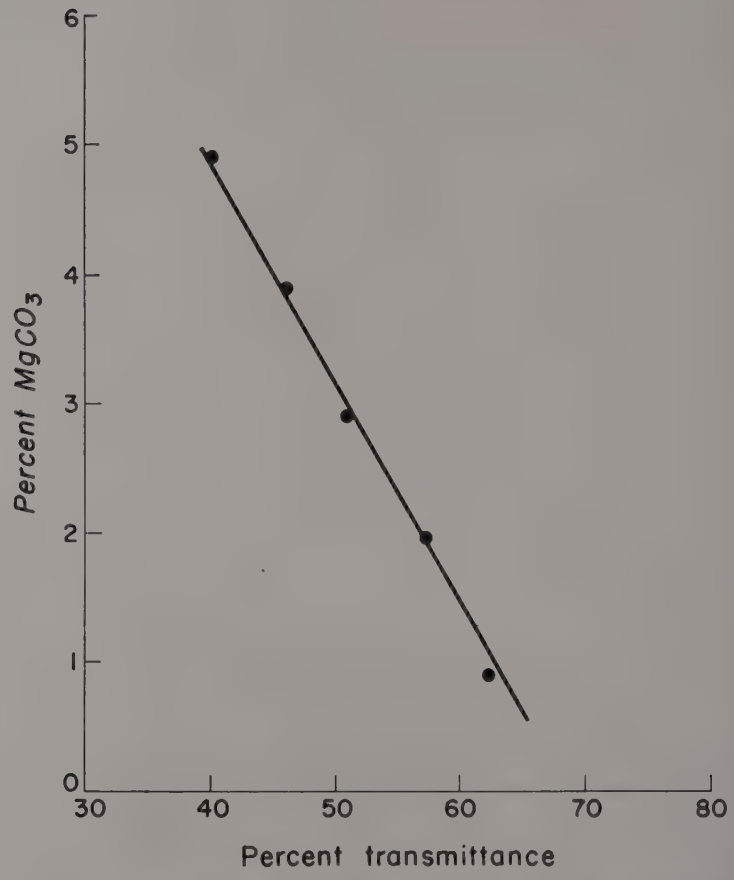

Fig. 1. Calibration curve for magnesium carbonate determination in marl.

cedure and method number 2 for samples A and B were .072 and .093 percent, respectively. Similarly the differences obtained in elemental magnesium between method number 1 and method number 2 for samples A and B were .015 and .021 percent, respectively.

Amounts of Calcium and Magnesium in Michigan Marl

Some calcium-magnesium carbonate relationships of several marl samples from various locations in Michigan were obtained. These samples were taken at random and do not reflect the chemical characteristics of the marl deposits in the various counties represented. As

TABLE 1—A comparison of the percent elemental magnesium obtained in two marl samples by the procedure employing thiazole yellow and two gravimetric procedures (a)

Sample	Percent magnesium		
	Thiazole yellow	Method 1(*b*)	Method 2
A	0.660	.603	.588
B	0.920	.834	.813

(*a*) The gravimetric determinations were carried out by the staff of the agricultural chemistry department, Michigan State University.

(*b*) Explanation of methods—

Method 1. Weighed portions of sample treated with HCl to dissolve Ca and Mg. Ca removed by repeated precipitations with $(NH_4)_2C_2O_4$. Mg precipitated as $MgNH_4PO_4$, ignited to $Mg_2P_2O_7$, and evaluated gravimetrically. Mn co-precipitated with Mg evaluated colorimetrically, and Mg values corrected accordingly.

Method 2. Weighed portions of sample treated with H_2SO_4 to convert Ca and Mg to sulphates. Majority of Ca removed by use of 75 percent ethanol. Remainder of Ca separated, and Mg precipitated, evaluated, and corrected, as in Method 1.

TABLE 2—Some calcium-magnesium carbonate relationships of marl samples from Michigan (a)

County	Percent $MgCO_3$	Pounds of $MgCO_3$ per cubic yard of marl	Pounds of $CaCO_3$ per cubic yard of marl	$MgCO_3$:$CaCO_3$
Berrien	3.50	34.2	942.8	1:27.57
Branch	1.95	26.3	1,323.7	1:50.33
Branch	2.70	49.5	1,783.5	1:36.03
Clinton	1.30	(*b*)	.....	.....
Clinton	3.75	40.1	1,029.9	1:25.68
Hillsdale	2.30	22.5	954.5	1:42.42
Jackson	3.55	....	.....	.....
Kalamazoo	2.50	38.2	1,488.8	1:38.97
Kent	2.30	19.4	822.6	1:42.40
Livingston	4.10	....	.....	.....
Livingston	3.75	31.2	800.8	1:25.67
Oakland	4.10	....	.....	.....
Osceola	4.30	....	.....	.....
St. Joseph	4.30	57.9	1,289.1	1:22.26
St. Joseph	4.45	38.4	824.6	1:21.47
St. Joseph	3.20	33.2	1,005.8	1:30.30
Van Buren	5.20	52.5	957.5	1:18.24
Van Buren	5.20	48.3	879.9	1:18.22
Van Buren	4.10	68.9	1,611.1	1:23.38

(*a*) The authors acknowledge the assistance given by J. Thornton of the soil science department in carrying out these analyses.

(*b*) Insufficient sample for the determination of these properties.

much as 85 percent variation has been obtained in the $MgCO_3$ content of the same marl deposit over a depth of 15 feet.

As shown in Table 2, the percent magnesium carbonate varied from 1.30 to 5.20, and the pounds of magnesium carbonate per cubic yard of marl varied from 19.4 to 68.9; the ratio of $MgCO_3$ to $CaCO_3$ varied from 1:50.33 to 1:18.22. The mean pounds of $MgCO_3$ and $CaCO_3$ per cubic yard of marl were 40.04 and 1,122.47 respectively. The average $MgCO_3$ content of the marl samples tested was 3.50 percent, equivalent to 1.67 percent MgO. The national mean MgO content of marl applied to the soil has been reported as 1.20 percent (Mehring, 1948).

Similarly, the estimated average MgO content of limestone for Michigan has been reported as 3.50 percent or 7.32 percent $MgCO_3$. More recent data,[1] however, have shown the average $MgCO_3$ content of all limestone materials used in Michigan to be 22.6 percent, and the average $MgCO_3$ content of all liming materials including marl to be 16.91 percent.

As shown in Table 3, 168,330 tons of high calcium stone, all quarried in Michigan, contained less than 2 percent $MgCO_3$. This tonnage represented 47.3 percent of the total limestone used in Michigan in 1956. This compared to 150,000 ton equivalents of marl having an average $MgCO_3$ content of 3.50 percent.

TABLE 3—The tonnage and magnesium carbonate content of the liming materials used in Michigan during 1956

Liming material	Tons of liming material used in 1956 Percent $MgCO_3$			
	43	15	3.50	2 or less
Limestone.....	175,329	12,145	.....	168,330
Marl and refuse.....	.....	.....	150,000	.....

It would appear advisable to consider this information in the establishment of a well-balanced soil management program. Soils that are acid and inherently low in magnesium and are limed frequently with high calcium materials may require supplemental applications of magnesium. This can be accomplished by periodic applications of a high magnesium liming material, such as dolomitic limestone.

[1]Unpublished data compiled by the soil science department, Michigan State University, East Lansing, Michigan.

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THE SOUTHWESTERN MICHIGAN FRUIT AND VEGETABLE FARM BUSINESS, 1957

II. CROP COSTS AND RETURNS[1]

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TYPICAL FRUIT AND VEGETABLE GROWERS in southwestern Michigan produce a wide variety of individual crops. Successful management of their farms calls for frequent re-examination of the kinds and acreages of crops grown and the practices followed. To make wise plans, growers need to know how changes with respect to any one crop can be expected to affect the success of the business as a whole.

Part I of this report summarized data relating to the total farm business activities of 18 fruit and vegetable growers in southwestern Michigan (Wheeler and Lord, 1958). Each of these growers produced several horticultural crops, and all but one grower sold products amounting to $5,000 or more in 1957. Almost all income on these farms was from sales of fruit and vegetables, and these crops occupied almost 50 of the 62 crop acres per farm.

Evidence from the present study points mainly to the wide variety of practices followed and results achieved in the production of several important crops. Determining the profitability of these varied practices would require much more refined data than are presently available. In the meantime, knowledge of the range of practices followed on other farms may help growers to see their own programs in a new light. Knowledge of average inputs and outputs, moreover, may help growers in thinking about possibilities in crops where their personal experience is limited.

[1]G. N. Motts and K. T. Wright of the department of agricultural economics, R. P. Larsen of the department of horticulture, and Alfred Dowdy of the department of entomology have reviewed a draft of this article. These individuals, as well as county extension workers in southwestern Michigan, have offered helpful comments and suggestions throughout the course of the study.

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LABOR INPUTS

Several groups of workers perform distinctly separate kinds of work at various stages in the production of fruit and vegetable crops. Important differences exist between pre-harvest and harvest labor, between hourly work and piecework, between unpaid and hired workers, and between direct work on individual crops as compared with general repair work and other miscellaneous jobs.

For these reasons, no single figure is here given as the total labor input for growing any one crop. Instead, the direct labor inputs of pre-harvest and hourly harvest labor, together with the expense for piecework harvesting labor, are presented in Table 1. Additional hourly work not allocated to any specific crop amounted to 11 hours per acre for the group as a whole (Table 2).

TABLE 1—Direct inputs of hourly labor and piecework per acre of bearing crops

Crop	Farms growing	Acreage per farm growing	Direct hourly labor(*a*)			Piecework labor(*a*)
			Harvest	Pre-harvest	Total	
	(Number)	(Acres)	(Hours)	(Hours)	(Hours)	(Dollars)
Apples	11	20	44	32	76	31
Peaches	12	11	82	53	135	8
Cherries (tart)	12	4	42	20	62	188
Grapes	6	6	16	44	60	32
Black raspberries	5	7	29	47	76	110
Asparagus	7	5	51	6	57	0
Strawberries	11	7	67	16	83	166
Tomatoes	12	6	139	47	186	16
All bearing crops	18	41	63	43	106	55

(*a*) The averages for individual crops give equal weight to data for each farm reporting. The bottom line, however, shows weighted averages for all bearing crops, including miscellaneous crops not listed above.

TABLE 2—Distribution of hourly labor according to sources and major uses

Source	Pre-harvest	Harvest	Miscellaneous	Total
	(Hours per acre of fruits and vegetables)			
Operator	16	17	9	42
Unpaid family	3	4	..	7
Hired	20	31	2	53
Total	39	52	11	102

Harvest Labor

Harvest labor, as the term is used here, includes not only the actual field work for picking and hauling, but also any packing-shed work performed on the farm, plus limited amounts of time spent in hauling to market and in other marketing activities. Altogether, these jobs accounted for much more than half of all labor inputs, and for an even larger fraction of the inputs of hired labor.

Berries, green tomatoes, most of the tree fruit except peaches, some of the grapes, and most of the processing tomatoes were harvested by piecework. The rates paid and the extent of their use may be summarized as follows:

Strawberries —A rate of 50 cents per 8-quart carrier prevailed for the fresh market berries. The rates paid for capped berries varied from 65 to 80 cents per carrier. Four growers paid 65 cents, one paid 75 cents, and two paid 80 cents.

Raspberries —Early in the season, growers paid 65 cents for an 8-quart carrier. As competition from the cherry harvest increased and as picking became more sparse, the rate advanced until it stood at about $1.00 toward the end of the season. The bulk of the crop was picked near the 65-cent level.

Cherries —Picking rates were quoted for pails and other containers of various sizes. The equivalent rate per pound was about 2½ cents on half the farms and a little below this level on the remainder.

Apples —Most apples were picked at rates between 15 and 25 cents per field crate. The average rate was below 20 cents, with higher rates usually paid for spot or top picking. Five growers paid hourly rates for part or all of the season.

Grapes —Most growers paid 20 cents per beer lug. Field crates or bushels were used occasionally, with payment at 30 cents. Two growers paid hourly rates for part of the harvest.

Tomatoes —The usual rate for green tomatoes was 14 cents per beer lug. Most of the pink tomatoes for fresh market were picked on an hourly basis. Toward the

end of the season, one grower paid hourly rates plus 5 cents per beer lug bonus. Another grower paid 17 cents per beer lug. Eight growers paid 15 cents per beer lug for picking ripe tomatoes for processing. Two more paid hourly rates.

Peaches —Most growers used hourly labor, but two paid by the bushel. The rate was 20 cents except for occasional spot picking at 25 cents.

Asparagus —Cutting or snapping was entirely hired by the hour.

During all these operations, hourly labor was commonly used for hauling from the field to the packing shed, for packing, and for other miscellaneous work. The operator's time for supervision, for hauling to market, and for selling was also recorded on an hourly basis.

Inputs of hourly harvesting labor varied considerably with the crops grown, yields, methods of sale, and other factors in the individual situation. In general, growers who had relatively high yields and sold most of their crop on a packed basis used the most hourly labor.

Peaches: These variations are well illustrated in data for the peach harvest (Fig. 1). The highest figure was 183 hours per acre, including 137 hours for picking the 260 bushels per acre, 39 hours for packing,

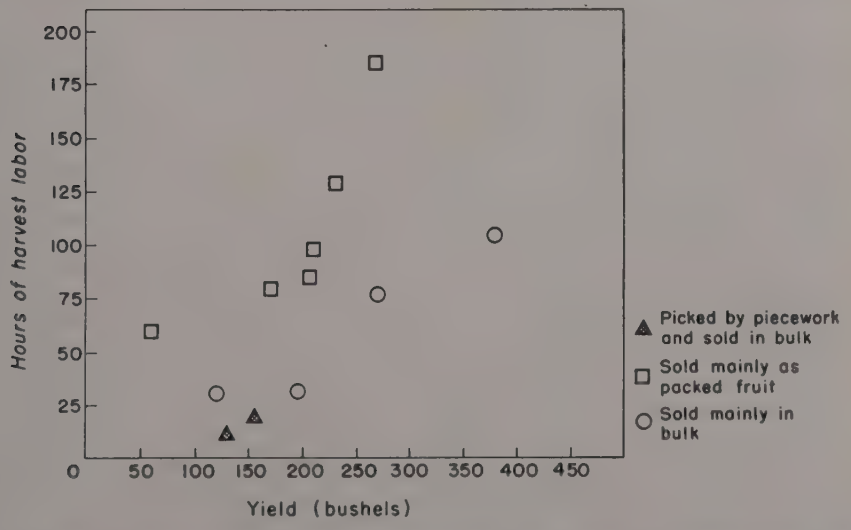

Fig. 1. Relationship between peach yields and hours of harvest labor by method of sale.

and 7 hours for marketing. The lowest figures were found on two farms with relatively young trees and low yields, where piecework rates were paid for most picking and where peaches were sold in bulk.

Asparagus: Labor for harvesting asparagus ranged from 11 to 104 hours per acre, most of the variation being associated with differences in yield. Per 1,000 pounds of asparagus harvested, the highest figure was 3.8 hours, and the average was a little above 3 hours.

Tomatoes: Three tomato growers used more than 300 hours of harvest labor per acre. A detailed breakdown by one of this group showed 169 hours, plus $16 for piecework, to pick the 16,000-pound crop; 120 hours for packing; and 16 hours for marketing. The other two used about the same amount of harvest labor per acre although their yields were nearer the 10,000-pound level and one of them sold more than half his crop in bulk. A fourth grower used 224 hours of harvest labor on a 16,000-pound crop sold mainly for processing. None of the remaining 8 growers used more than 100 hours of harvest labor per acre. Three of them reported only about 80 hours per acre to pick, pack, and market crops of about 8,000 pounds per acre. Two more reported about 60 hours per acre on crops of about 4,000 pounds per acre sold in bulk. The last three, also selling in bulk, reported about 30 hours plus $50 worth of piecework per acre on crops yielding 9,000 pounds or more.

Apples: Two apple growers who packed none of their crop and depended on piecework labor for most of their picking reported less than 10 hours per acre for other harvest work. Most growers used 30 to 50 hours plus $30 to $50 for piecework labor, with additional amounts of hourly labor in the few cases where a large share of the crop was packed.[2] Two growers who hauled their crops to fruit exchanges for packing and sale were able to harvest crops averaging 435 bushels per acre with an outlay of $37 for picking by piecework and only 40 hours of other harvest labor per acre.

Strawberries: The large amounts of piecework used in picking the strawberry crop seemed to require somewhat proportional inputs of hourly labor for supervision, time-keeping, and packing. None of the six growers with yields below 150 crates used more than 50 hours per acre, whereas four of the growers with yields above 150 crates used around 100 hours per acre and the fifth used 156 hours per acre.

[2]Packing operations commonly use .1 to .2 hours per field crate dumped, according to data from Gillette and French (1957).

Cherries: Variation in the amount of hourly labor used for the cherry harvest, on the other hand, showed little relation to yield. The range was from 16 to 74 hours per acre, both figures being reported from farms with slightly below average yields. The growers with the two highest yields used only about 50 hours per acre.

Hourly wages: Hourly wages during the harvest season ranged from 50 cents for some children to $1.25 for a field boss in strawberries. Most growers used several hourly rates for different classes of workers. The typical range for casual workers was 65 to 75 cents per hour. Men working on a steady basis commonly received 70 to 75 cents per hour —a few cents higher than for women. Foremen often received 80 cents to $1.00 per hour.

Pre-harvest Labor

Pruning and thinning: Pruning and thinning accounted for a large share of all pre-harvest labor for apples, peaches, and grapes (Table 3). Apple pruning occupied much of the operators' time in periods of good weather from December through April. Grape pruning and tieing also started during this period, but peach pruning began later in the season.

Pruning time for seven of the apple growers ranged between 11 and 32 hours per acre. One grower spent as much as 41 hours per acre, while another completed his 1957 pruning in December of 1956 and did not start pruning again until 1958. Two of the peach growers

TABLE 3—Pre-harvest labor inputs per acre of selected bearing crops (a)

Crop	Prune	Thin	Spray	Prepare soil and plant	Cultivate (tractor)	Other (b)	Total
	(Hours per acre)						
Apples	17	1	10	..	1	3	32
Peaches	18	21	6	..	4	4	53
Cherries	9	..	5	..	4	2	20
Grapes	33(c)	..	6	..	3	2	44
Black raspberries	24	..	3	..	3	17	47
Asparagus	..	..	1	..	4	1	6
Strawberries	..	..	2	..	..	14	16
Tomatoes	..	..	3	26(d)	3	15	47

(a) The averages give equal weight to data from each farm reporting.
(b) Includes irrigation, mulching, hoeing, and other work.
(c) Includes tieing.
(d) Includes time for growing plants on three farms.

reported upwards of 40 hours per acre for pruning, raising the average for the group considerably. Pruning time for the remaining 10 peach growers ranged from 2 to 19 hours per acre (averaging 10 hours). The time for pruning grapes ranged from 12 to 49 hours per acre.

Spray thinning was the usual practice for apples, but peaches were thinned by brushing at blossom time or by other hand-thinning methods. Four growers spent upwards of 25 hours per acre in thinning peaches, while three spent only 1 to 5 hours per acre.

Spraying: Spraying was almost a continuous process between April and July for some of the larger tree-fruit growers. The time consumed in spraying varied with many factors, including the number of separate applications for the season.

Apples usually received the equivalent of 15 to 18 complete sprays (Table 4). This count is only approximate because the amount of coverage varied from spray to spray. In some cases, all trees were sprayed on opposite sides, or from two directions, within periods ranging from a few minutes to several days. In other cases, trees were sprayed from only one side, or only part of the orchard was covered.

TABLE 4—Typical numbers of complete sprays for selected bearing crops, by months

Crop	Number of sprays, by months						
	April	May	June	July	Aug.	Sept.	Total
Apples	4	4	3	3	2	1	17
Peaches	1	3	2	2	2	.	10
Cherries (tart)	.	2	3	1	.	.	6
Grapes	.	1	2	1	2	.	6
Asparagus	1	.	.	.	.	.	1
Strawberries	1	2	1	.	.	.	4
Strawberries (n. b.)	.	.	.	.	.	1	1
Tomatoes(*a*)	.	.	1	2	1	.	4

(*a*) The timing of sprays varied considerably with the date of planting.

Crops other than apples received fewer sprays, but these were largely bunched in May and June, which proved to be critical months for spray labor on farms with several kinds of fruits and vegetables.

Growers achieved the desired coverage for trees of a given size by adjusting the concentration of the spray, the output of the sprayer, the rate of travel through the orchard, and the number of passes for

each two rows of trees. This number could vary from one to four, depending upon whether spray was directed from one or both sides of the sprayer, or whether trees were to be covered on one or two sides. The time for refilling the sprayer also affected the number of acres that could be covered in a day. When the source of water is far removed from the orchard or inadequate in amount, the use of concentrate sprays is especially attractive.

Under favorable conditions, one man using a medium capacity airblast sprayer can apparently keep up with the spray program for 100 or more acres of tree fruit. On the 18 farms, the operators themselves performed nearly all the spraying.

Planting: Soil preparation and planting operations applied to only a small percentage of the acreage on the 18 farms, tomatoes being the only annual crop common to most of the group. The 26-hour average time for planting the tomatoes would also apply fairly well for cauliflower and other transplanted crops.

Cultivation: Cultivation for tree fruit consisted mainly of discing, with occasional use of a tree hoe, especially in the fall. The highest individual report for time spent in tractor cultivation of any crop was 7 hours per acre.

Irrigation: Irrigation was available on six of the 18 farms, but its use was restricted in 1957 because of the generally favorable moisture conditions. Five of the six growers made use of their equipment for protecting strawberries from frost, and four of the five also irrigated tomatoes. One of the latter used his system to provide frost protection for tomatoes late in the fall, and other crops were irrigated to a limited extent.[3] Altogether, only a small amount of time was spent on irrigation. Mulching, hoeing, and other miscellaneous jobs made up the remainder of the pre-harvest work.

Non-bearing crops: Labor inputs on non-bearing tree fruit were difficult to record accurately because the acreages were small, the trees were frequently interplanted with other crops, and the operations were intermingled with similar work on bearing trees. In general, fewer sprays were applied and the time per spraying was less.

Labor inputs on seven non-bearing strawberry beds averaged 27 hours for soil preparation and planting, three hours for tractor cultivation, and 72 hours for hoeing, totaling 102 hours per acre. One

[3]Possibilities in irrigation are discussed by Hoglund, Kidder, and Vary (1956).

grower reported a total of only 25 hours per acre, including 13 for planting, 10 for hoeing, and two for cultivating. Four growers reported totals above 100 hours per acre, including about 140 hours of hoeing time alone in two of the four cases. The range for planting time was from 10 to 58 hours per acre, and for tractor cultivation from two to five hours per acre.

Sources of labor: Growers and their families performed most of the pre-harvest work on farms where there were no more than 40 acres of fruit per operator. Hired laborers performed most of the pre-harvest work except spraying where there were more than 60 acres per operator. For the group as a whole, about half of the pre-harvest work was hired (Table 1).

Material Inputs

Fertilizer: Each grower used some fertilizer on all or nearly all of his crops, but the kinds and amounts per acre varied widely. (The most common analyses were 12-12-12 and 5-20-20 or similar 1-1-1 or 1-4-4 ratios.) Several growers sprayed solutions containing additional nitrogen on tree fruits and tomatoes. Starter solutions made from high analysis fertilizers were applied when planting tomatoes, strawberries, and other crops. Supplemental applications of nitrates and phosphates in dry form were made in several instances. Manure was purchased for use on a few fields needing additional organic matter, and lime was applied to one or more crops on several farms.

TABLE 5—Expenses for fertilizer and spray materials per acre of selected bearing crops

Crop	Fertilizer, lime, mulch		Spray materials	
	Average	Range	Average	Range
	(Dollars per acre)			
Apples	13	1 to 24	63	37 to 90
Peaches	16	4 to 47	31	17 to 63
Cherries (tart)	12	4 to 29	23	8 to 37
Grapes	31	5 to 39(*a*)	11	7 to 13
Black raspberries	20	4 to 40	10	3 to 14
Asparagus	42	20 to 75	8	1 to 24
Strawberries	13	0 to 30	9	0 to 25
Tomatoes	20	1 to 37	16	2 to 37

(*a*) One grower spent a larger amount in building up organic matter and liming, and making heavy corrective applications of fertilizer.

In total, these applications involved expenditures averaging from $12 per acre on cherries to $42 per acre on asparagus (Table 5). A considerable range appears in the expense on any one crop, partly because growers occasionally skip their usual fertilizer applications. This may happen in the year following a short crop or for various other reasons. Over a period of several years, few growers would repeatedly spend as little for fertilizer as the low figures in the second column of Table 5. Growers making the high applications, however, would be more likely to repeat them from year to year.

Spray materials: Expense for spray materials varied from the $90 per acre reported by one apple grower to negligible amounts for strawberries, asparagus, and tomatoes on a few farms (Table 5). Spray programs for specific situations can be formulated with alternative combinations of dozens of materials varying in price, suggested application rates, and in effectiveness. Thus, within limits, growers have opportunities to choose between cheaper and more expensive programs giving relatively favorable degrees of control.

In 1957, however, the range in spray expense per acre for each of the several crops seemed more the result of differing control problems than of varying responses to common problems. Controlling serious apple scab infections in two or three orchards, for example, called for large expenditures that were unnecessary on other farms. One grower could have formulated a much cheaper spray program if he had not been physically sensitive to certain effective but hazardous chemicals.

On the whole, the 1957 spray program was regarded by growers and extension workers as relatively successful; there seemed to be few cases where larger or smaller expenditures could have been expected to produce much more favorable results. Prices paid for individual items varied considerably, however, suggesting that some growers might have been able to buy to better advantage. Also, growers might have been able to attain improved results through better timing of sprays and improved application procedures, even with no change in their total outlays for materials.

Packages: The added cost of selling crops on a packed basis instead of in bulk included a substantial expense for the package itself. In several cases, more than one type of package was in use for a given crop, so Table 6 shows a price for each main type of container as well as the average expense per unit packed. Except for used packages, the prices paid were fairly uniform.

TABLE 6—Package expense per unit of selected crops

Crop	Package	Price of package		Average package expense per unit packed
		Typical	Range	
Apples and peaches	Complete bushel(*a*)	$.52	$.52 to .58	
	Open bushel	.26	.25 to .28	
	All			$.52 per bu.
Grapes	Jumbos (12 qt.)	.19	.19 to .19½	
	8-box carton (16 qt.)	.80		
	All			$.34 per 100 lb.
Black raspberries	24-pt. crate (*c*)	.80	.67(*b*)to .80	$.76 per crate
Strawberries	16-qt. crate(*c*)	.70	.53(*b*)to .78	$.69 per crate
Tomatoes	8-basket crate(*c*)	.82	.82 to .87	
	8-qt. carton	.15½	.15 to .16	
	Jumbos (12 qt.)	.19	.19 to .19½	
	16-qt. crate(*c*)	.55(*b*)	.55(*b*)to .68	
	All			$1.77 per 100 lb.

(*a*) Includes cover, liner, fringe, and pad.
(*b*) These prices were for used crates.
(*c*) Includes individual baskets.

Seeds and plants: Seeds, plants, and nursery stock were infrequent items of expense for the 18 cooperating growers. Tomato growers spent $13 per acre for seeds and plants.

PRODUCTION AND SALES

For most crops, the total quantities sold per acre were well above the state average yields reported for 1957 by the Cooperative Crop Reporting Service. The opposite was true for tomatoes, however. The quantities of each crop sold varied widely among the cooperating farms (Table 7).

For tree fruits, some of this variation was obviously associated with the age of orchards. Some vegetable production was left unharvested, either because of low prices or because of competition from other crops. Growers with six or eight crops to harvest in a short period of time often find that slight variations in growing conditions or other circumstances can force them to neglect the harvest of a minor crop in favor of a more important one.

Much of the variation in prices for the several crops reflected merely the added cost of the packages and labor used in selling on a

TABLE 7—Sales per acre of selected bearing crops

Crop	Unit	Quantity sold		Price	Receipts per acre	
		Average(*a*)	Range		Average(*a*)	Range
Apples—packed for fresh market	bu.	53	0 to 290	Mostly $1.65 to 2.35(*b*)		
—fresh, bulk(*c*)	bu.	178	26 to 380	Mostly $1.00 to 1.25		
—juice	T.	0.2	0 to 0.8	Mostly $15		
—processing	lb.	600	0 to 1,800	Mostly 2 to 2½¢		
Total	bu.	256	84 to 490	Average $1.30	$340	$160 to 520
Peaches—packed for fresh market	bu.	98	0 to 260	About $2.60		
—fresh, bulk(*c*)	bu.	85	0 to 390	About $1.40		
—processing	T.	0.4	0 to 2.4	About $60		
Total	bu.	200	59 to 390	Average $2.05	410	130 to 710
Cherries (tart)—processing	lb.	8,000	2,800 to 16,000	About 7¢	560	200 to 1,130
Grapes—packed for fresh market	lb.	620	0 to 3,900	About 6¢		
—for wine	T.	0.5	0 to 2.8	$85		
—for juice	T.	2.2	0 to 3.1	(Not available)		
Total	T.	3.1	2.0 to 4.6	(Not available)	(Not available)	
Black raspberries—packed berries for fresh market	24-pt. cr.	3	0 to 9	$4.25		
—processing berries	lb.	1,830	510 to 3,400	About 19½¢		
—total berries	lb.	1,890	510 to 3,400	Average 19¢		
—plants	thous.	1.3	0 to 3.6	$30 to 40		
Total	.....	.....	.....	.....	410	100 to 660

TABLE 7—Concluded

Crop	Unit	Quantity sold		Price	Receipts per acre	
		Average(*a*)	Range		Average(*a*)	Range
Asparagus—processing	lb.	1,520	730 to 2,800	Average 13.8¢	210	100 to 400
Strawberries—packed for fresh market	16-qt. cr.	143	23 to 280	Mostly $3.00 to 4.00		
—for processing	lb.	322	0 to 1,500	Mostly 10 to 11¢		
Total	16-qt. cr.	165	23 to 360	Average $3.56	590	90 to 1,180
Tomatoes—packed for fresh market in 8-basket crates	16 qt.	46	0 to 150	Mostly $2.00 to 2.40		
—in cartons	8 qt.	129	0 to 680	Variable		
—in jumbos	12 qt.	39	0 to 140	Mostly 60 to 90¢		
—in 16 qt. crates	16 qt.	5	0 to 60	About $2.00		
Total packed	16 qt.	145	0 to 500	Average $2.05		
—Green, bulk	T.	1.5	0 to 5.2	Variable		
—processing	T.	2.0	0 to 7.5	About $26		
Total	T.	5.0	1.8 to 8.1	Average $80	400	60 to 790(*d*)

(*a*) The averages give equal weight to data for each farm reporting.
(*b*) Delicious sold at the top end of this range, with most other varieties near the lower end.
(*c*) Includes sales through fruit exchanges.
(*d*) One farm omitted.

packed basis. Few of the growers seemed to feel that these added expenses in 1957 produced much more than an equal increase in receipts, as compared with sales in bulk or for processing.

COMPARISONS WITH RESULTS OF OTHER STUDIES

Pre-harvest labor inputs on fruit crops are markedly lower than those reported by Wright and associates (1946) in their studies of 1943 fruit costs in Michigan. Yield increases, in the meantime, have been large, although somewhat erratic from year to year. Labor for picking the various fruit crops seems to have increased about in proportion to the increases in yield.

Pre-harvest labor inputs on apples, for example, were 51 hours in 1943 as compared with 32 hours in 1957; yet the average yield on the farms studied in 1943 was only 108 bushels as compared with 256 bushels on the farms studied 14 years later. On peaches, the pre-harvest labor inputs fell from 67 to 43 hours, and on tart cherries from 40 to 20. In each case, much of the saving was in spraying time, reflecting the introduction of spraying equipment readily handled by one man instead of two. Apple spraying in 1943 accounted for 20.9 man hours per acre, as compared with only 10 hours per acre in 1957.

Pruning time showed little change between the two periods. This was true for black raspberries as well as for the tree fruits.

Hoeing and other manual labor on new strawberry beds was sharply reduced, the total pre-harvest labor inputs being 209 hours per acre in 1943 but only 102 hours in 1957.

Although production practices and conditions differ in other states and areas, the 1957 data correspond in a number of respects with other reported results. Stanton and Dominick (1957), for example, report 1956 pre-harvest labor for apples on three sizes of western New York fruit farms averaged 46, 40, and 37 hours per acre.

Dominick (1957) also reported pre-harvest 1957 labor inputs and spray material expense for sour cherries in Monroe County, New York, that correspond closely with the data here reported.

Studies of tomatoes grown for processing in western New York (Stanton and Stevens, 1956) and in Ontario (Nelson, 1954) showed markedly higher yields than the southwestern Michigan farms. The latter, however, grew most of their tomatoes for the fresh market. In these three studies, pre-harvest labor inputs were again roughly similar.

Reports on costs of producing grades (MacCharles, 1956) and

raspberries (Nelson and Peart, 1956) in Ontario provide interesting comparisons with the results reported here. Preliminary data for a group of rather specialized grape farms in Chautauqua County, New York, have also been released by the County Extension Service and the Department of Agricultural Economics of the New York State College of Agriculture (1957).

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MARKET VALUE OF NON-EXPENDITURE FOODS OBTAINED BY GIFTS, HOME GROWN, AND HUNTING AND FISHING[1]

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FOOD CONSUMPTION STUDIES, in general, have given little or no attention to foods which are not actually purchased. Most families obtain some "free" foods sometime during the year from gifts, from the home garden, or from hunting and fishing. How "free" they are is open to question.

Wives sometimes feel that food obtained from hunting and fishing is pretty expensive. Home gardens may not be efficient sources if all costs are allocated to food. Gifts have sometimes been termed a social loss. That is, they are often exchanges between persons, and neither receiver would have spent his money that way had he made the purchase himself.

"Gifts" won in games of chance are often costly, at least over the short run. In none of these cases do people pay a particular market price for the items. Often these foods are not considered part of the food budget.

In this report, food obtained from these non-purchase sources is assigned a retail price with the objective of determining some measure of value to indicate its relative importance. Differences among families are computed and differences among products are determined.

The source of data is the M.S.U. Consumer Panel. The data apply only to food brought into the home. The sample area is a Michigan city of about 100,000 population. Computations are made for 1955 only.

Retail prices were based on the actual purchases of particular foods by families in the Panel.[2] Seasonal prices for foods produced

[1]M.S.U. Consumer Panel Report No. 47.

[2]Retail prices for non-expenditure items were assigned by Dr. Louise Kelley of the foods and nutrition department.

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locally or usually available at certain times of the year were considered. Products which were not on the market, such as venison or game birds, were assigned prices similar to those of comparable kinds of products. Since the families reported products as they were brought into the home, prices and values apply to products, fresh or processed.

The real advantage of the Consumer Panel as a source of data was that highly seasonal products are included. All of the 176 families included in the analysis provided records for each week of the year. One-time surveys do not obtain data of this nature. Most food consumption studies obtain data for very short periods.

VARIATIONS AMONG FAMILIES

The ratio of non-purchased foods to purchased foods varied widely among families. Seven of the 176 families reported no non-purchased foods during the year. In contrast, for one family, the ratio was .32, or the value of non-purchased food was equal to 32 percent as much as that of purchased food. The frequency distribution of these ratios follows:

Ratio of non-purchased to purchased food	No. of families
.0000	7
.0001 to .0199	47
.0200 to .0399	44
.0400 to .0599	26
.0600 to .0999	32
.1000 and over	20

The weighted average ratio for all families was .045. The total retail value of non-purchased food for the 176 families was $6,816, or an average of $39 per family. The total amount paid for food for use at home was $151,293, or an average of $860 per family.

An attempt was made to determine whether the ratio of non-purchased food to purchased food was related to such family characteristics as education of the homemaker, size of family, per capita income of the family, or age of homemaker. There appeared to be no relationship to education. However, the ratio tended to decline as size of family and per capita income increased. It tended to be higher as the homemaker grew older. This is illustrated in Table 1.

TABLE 1—Ratio of value of non-purchased to purchased food—size of family, per capita income and age of homemaker

Characteristic	Number of families	Average ratio of value of non-purchased to purchased food(*a*)
Size of family		
1.00—1.99	18	.0740
2.00—2.99	63	.0492
3.00—4.99	75	.0542
5.00 and over	20	.0272
Per capita income		
Under $1,000	20	.0733
1,000—1,999	81	.0504
2,000—2,999	46	.0456
3,000—3,999	18	.0321
4,000 and over	7	.0526
Unknown	4	.0982
Age of homemaker		
19—29	14	.0328
30—39	43	.0381
40—49	37	.0505
50—59	47	.0659
60 and over	35	.0562

(*a*) Simple average of the ratios for each family.

It was hypothesized that families with gardens, home freezers, or who did home canning, likely obtained more non-purchased foods than those who didn't. Having a garden particularly influenced this, as shown in Table 2.

TABLE 2—How gardens affected food purchased

Characteristic	Number of families	Average ratio of value of non-purchased to purchased food(*a*)
Had vegetable garden	49	.0908
Did home canning of fruits or vegetables	108	.0606
Both: had garden and canned	43	.0938
Had home freezer or rented food locker	27	.0557
Three: had garden, canned, had freezer or locker	10	.0884
Did not can fruits or vegetables	68	.0338
Had no vegetable garden	127	.0346
Canned, but had no garden	65	.0387
All families	176	.0502

(*a*) Simple average of ratios for each family.

VARIATION AMONG FOODS

Non-purchased foods are comprised of a wide variety of different foods, although fruits and vegetables make up slightly more than half of the total. Table 3 gives the value of the non-purchased items, the value of purchased items, and the proportion comprised of each of the major food groups.

TABLE 3—Value of non-purchased items, value of purchased items and proportion of each of the major food groups

Food group	Value of non-purchased items (dollars)	Value of purchased items (dollars)	Distribution of non-purchased items (percent)
Dairy products	264	26,115	3.87
Fats and oils	33	6,741	.48
Meats	603	34,845	8.85
Poultry, eggs, fish and seafood	1,118	14,253	16.40
Fruit	1,616	15,436	23.71
Vegetables	2,202	14,427	32.31
Cereal products	287	19,046	4.21
Sweets, desserts, nuts	379	6,409	5.56
Cooking aids	3	1,008	.04
Beverages	311	13,013	4.56
Total	6,816	151,293	100.00

Among the major food groups there are typically a few products which assume fairly great importance. Among dairy products, ice cream and sherbets are the leading non-purchased items. Butter is the chief one among fats and oils. Steak is the leader among beef items, and ham accounts for a large proportion of the pork. Venison is an important item. Among poultry products, turkey is the leader by far. In an area like Michigan, fish is a fairly significant item.

Leaders among the fruits are fresh raspberries, strawberries, apples, peaches, and pears. For some items non-purchase values exceed those of purchases, such as fresh blackberries and dewberries, raspberries, sour cherries, pears, and rhubarb. Fresh tomatoes lead vegetable items by a wide margin, and the families in this study actually obtained more by non-purchase methods than they bought.

To illustrate the major items in detail, Table 4 gives the values for food groups and each food item in which the value of non-expenditure items exceeded $25.

TABLE 4—Values for food groups and each food item in which value of non-expenditure items exceeded $25

Food product	Value of non-purchased items (dollars)	Value of purchased items (dollars)	Ratio of value of non-purchased to purchased
Dairy products	264	26,115	.0101
Fresh milk	39	17,446	.0022
Canned and dried products	1	643	.0015
Fresh cream	29	1,094	.0265
Ice cream, sherbets, etc	146	3,207	.0455
Cheese	47	2,433	.0193
Cottage cheese	3	1,292	.0023
Fats and oils	33	6,741	.0048
Butter	18	3,430	.0052
Other fats	6	2,148	.0027
Oils	9	1,162	.0077
Beef	161	16,459	.0097
Ground beef, hamburger	28	4,600	.0060
Roast	30	4,124	.0072
Steak	81	5,155	.0157
All other beef	22	2,580	.0085
Lamb and mutton	2	357	.0056
Pork	188	11,864	.0158
Ham	137	3,412	.0401
All other pork	51	8,452	.0060
Veal	6	867	.0069
Variety meats, game, etc	246	5,298	.0464
Weiners, bologna, cold cuts, etc	34	4,258	.0079
Venison, rabbits, game	206	30	6.8666
All other, incl. meat soup, etc	7	1,010	.0069
Poultry	482	5,516	.0873
Broilers and fryers	79	2,192	.0360
Roasters	58	397	.1460
Stewing chicken	55	872	.0630
Turkey	234	1,123	.2083
Game birds	30	0	infin.
All other poultry	26	932	.0278
Eggs	173	6,283	.0275
Fish and sea foods	463	2,454	.1886
Fruit	1,616	15,436	.1046
Fresh fruit	1,493	7,678	.1944
Blueberries	34	157	.2165
Blackberries and dewberries	53	9	5.8888
Raspberries	234	178	1.3146
Strawberries	142	516	.2771
Other fresh berries	15	65	.2307
Grapefruit	72	566	.1272
Oranges	98	906	.1081
Other fresh citrus	13	448	.0290
Apples	166	1,372	.1209
Sour cherries	60	27	2.2222
Grapes	62	277	.2238
Cantaloupe	66	459	.1437
Watermelon	25	307	.0814

TABLE 4—Concluded

Food product	Value of non-purchased items (dollars)	Value of purchased items (dollars)	Ratio of value of non-purchased to purchased
Fruit, cont'd.			
Fresh fruit, cont'd.			
Peaches	135	422	.3199
Pears	130	116	1.1206
Plums	64	82	.7804
Rhubarb	90	13	6.9230
All other fresh fruit	35	1,758	.0199
Frozen fruit	36	2,553	.0141
Canned fruit	61	3,999	.0152
Dried fruit	9	462	.0194
Jams and jellies	13	312	.0416
Baby food fruit, candied fruit, etc.	4	432	.0092
Vegetables	2,202	14,427	.1526
Fresh vegetables	2,119	6,917	.3063
Cabbage	50	289	.1730
Lettuce—leaf	37	28	1.3214
Beans—snap	101	75	1.3466
Carrots	68	417	.1630
Sweet corn	130	168	.7738
Mature onions	25	332	.0753
Peppers	46	141	.3262
Squash	34	123	.2764
Cucumbers	167	216	.7731
Potatoes	159	1,795	.0885
Tomatoes	1,092	684	1.5964
Other fresh vegetables	212	2,649	.0800
Frozen vegetables	13	906	.0143
Canned vegetables	42	3,923	.0107
Dried vegetables	15	1,053	.0142
Other, baby food, soup, etc	13	1,628	.0079
Cereal products	287	19,046	.0150
Breakfast cereals	6	1,818	.0033
Bread	55	6,642	.0082
Crackers, rolls, buns, etc	31	3,122	.0099
Cakes	69	856	.0806
Cookies, doughnuts	58	3,116	.0186
Pies	30	453	.0662
Prepared mixes, flour, etc	10	2,098	.0047
Spaghetti, macaroni, rice, etc	28	941	.0297
Sugar, candy, syrup, sweets, etc	241	4,104	.0583
Prepared dessert mixes	4	697	.0057
Nuts	133	1,608	.0827
Cooking aids	3	1,008	.0029
Beverages	311	13,013	.0238
Beer	78	2,415	.0322
Liquors and wine	124	1,663	.0745
Coffee	92	6,582	.0139
All other	17	2,353	.0072
Total	6,816	151,293	.0450

CAN SEASONAL VARIATION IN HATCHABILITY DEPEND ON SAMPLING METHODS?

By EARL W. HENDERSON[1]

DEPARTMENT OF POULTRY HUSBANDRY

A SURVEY AMONG HATCHERYMEN would probably reveal as many answers to the title question as there are hatcherymen. It is well known that eggs for commercial hatching purposes come from a wide variety of breeds, strains, and environments. Published experimental data, obtained under recorded breed and uniform environmental circumstances, are meager and inconclusive.

PARTIAL REVIEW OF EXPERIMENTAL REPORTS

Two of the more recent reports[2] [3] from which it is possible to estimate seasonal variation of hatching power show no definite trend. The data of these reports differ widely in scope and quantity. In both studies, seasonal trends are incidental to the main objective and neither contain records of the hatching performances of individual hens. Individual variation is, of course, fundamental to valid biometric analysis.

In both studies the variation between seasonal averages was small and would, no doubt, be judged sufficiently conclusive by current standards.

OBJECT

One purpose of this report is to measure the relative stability of hatching power within individual hens from season to season, or, more

[1]The assistance of Mr. Kenneth Rood, technician, in operating incubators and recording hatches is gratefully acknowledged.

[2]Touchburn, S. P., J. Biely, and B. March (1957). The effect of dehydrated green feed on fertility and hatchability of eggs from three generations of New Hampshire chickens. Poult. Sci. 36(3): 591-595.

[3]Balloun, S. L., and R. E. Phillips (1957). Interaction effects of Vitamin B_{12} and pantothenic acid in breeder hen diets on hatchability, chick growth, and livability. Poult. Sci. 36(5): 929-934.

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specifically, from late winter to late spring or early summer. The results may also suggest some reasons for using individual pedigreed hens of proved hatching power in research instead of "randomly" selected unproved hens or pullets. The use of samples of eggs from individual hens of proved merit should reduce the numbers of hens and size of test lots required to measure unknown factors. The use of pedigreed eggs from proved hens is emphasized because of the consistency of hatching power within the individual hens. There is also wide variability between hens of the same breed or strain and on the same feed.

Reasons for Michigan Study

It is well known that small trends are important to commercial operators and experiment station workers alike. Hatchability is commonly used as a measuring stick for the potency of vitamins, antibiotics, and/or trace elements in feeds. Such tests require maximum stability of as many known biological and mechanical factors as possible along with experimental procedures which will permit adequate statistical analysis of results.

Since we were not aware of seasonal studies in which the hatching performances of individual hens had been evaluated statistically, it seemed worthwhile to examine the hatching records of Michigan Agricultural Experiment Station Project 266.

PROCEDURE

Reasons for Sampling Procedure

Most experimenters feel that samples of test material should be "large" and, of course, unbiased. There is considerable doubt as to how "large" samples should be and how to avoid bias. Statisticians especially, place a great deal of faith in the principle of size and randomness. They seem to expect the laws of chance to overcome any biological bias that may exist in samples.

Incubator operation, which is a kind of air conditioning process, is normally controlled mechanically within narrow limits with considerable precision. Therefore sampling of incubators may be relatively unimportant in many cases.

Most experimenters accept the foregoing principles in general. They can compute the approximate size that samples should have

been after a number of similar experiments have been completed and normal variation has been determined. From this information, the optimum sample size of future experiments can be estimated.

Facilities Usually Limited

Unfortunately, experimenters are often forced by circumstances to get results with limited numbers and facilities and to choose the numbers in samples before experiments are begun. Such a situation requires considerable technical experience with the past performance of the fowls in question, under a wide variety of circumstances. As a rule, on most experimental farms, populations of chickens are not large enough to permit the principle of randomization to equalize potential performance between samples. In such cases it is not possible to depend on the axiom that "the larger the sample the closer the average will approach the average of the race."

Nutritionists especially, should be interested in sampling for they frequently work with small quantities of expensive chemical compounds and are forced to limit the size of test lots. Laboratory workers whose experience may be limited to highly purified compounds of exact chemical composition may be inclined to place a great deal of faith in the principle of using "control" or "check" lots. A fact frequently overlooked is that the control or check lot itself is only a sample from an infinitely large population.

Individual Variation is Common

Many experienced research workers have found that there may be considerable individual variation in hatching power under the most rigidly controlled conditions available, and that individual variation is fundamental for statistical evaluation of results.

METHODS

Breeding Stock

In order to get as many generations as possible each year, eggs have been set from Project 266 at two seasons of the year, usually mid-winter and late spring. In many cases eggs have been set at weekly or biweekly intervals from January to June. All hens and eggs are individually pedigreed from single male mated pens as

routine practice. It was possible therefore to select hatching records of hens which had substantial numbers of eggs set at two or more seasons of a year.

Two Methods of Comparing Hatching Power

Two methods of comparison of hatching power will be demonstrated with data compiled from the same flock during two seasons of the year (January to June). In the first example the results will be compiled by a rather common method, *i.e.* pooled averages of eggs from ten lots of hens as they might be selected at random with no previous knowledge of potential hatching power.

Hatchability of these pens was tested at two seasons of the year. Information as to whether or not each individual hen in each lot produced eggs in both seasons was ignored on the assumption that it would not be available under a blind random sampling method.

No restriction was placed on the number of eggs set from each hen since the pen averages only would be available normally. Such a method of pen evaluation is all that would be possible from pen lots of unpedigreed eggs.

In another example the hatching records of 100 individual hens which produced a minimum of five fertile eggs during **both** seasons were chosen at random from the entire flock. Their individual hatching performance records during both seasons of the year were analyzed statistically.

Management

All hens were confined to a common house in pens of 15-20 with a single male. They were fed the same "all mash" feed mixtures throughout the experimental period. Eggs were gathered and stored at weekly intervals prior to setting after which they were set in the same incubator.

RESULTS

From Table 1 it is apparent that the pen averages of the hypothetically random-selected lots vary from 61 percent (as usually computed) to 96 percent. Since all the hens in the several lots got the same environmental treatment, Tables 1 and 2 illustrate the variability which could result from "blind" random selection alone. Furthermore, the hatchability of individual hens varies from 38 to 100 per-

TABLE 1—"Early" season versus "late" season hatchability of ten pens of "randomly"(a) selected hens

Pen number	"Early" season			"Late" season		
	Fertile eggs	Number hatched	Percent hatch	Fertile eggs	Number hatched	Percent hatch
1	51	44	86	33	20	61
2	81	70	86	23	19	83
3	74	66	89	24	18	75
4	47	41	87	41	33	80
5	76	61	84	32	25	78
6	64	51	80	35	29	83
7	40	36	90	29	21	72
8	56	47	84	38	25	66
9	23	18	78	56	53	95
10	56	43	77	25	24	96
Totals	568	477	84	336	267	79

(a) 700 hens and/or pullets were distributed among 35 pens, entirely at random with respect to hatching power. Ten hens, each from ten of the pens, were then selected for this demonstration from the 35 pens on the basis of the largest number of fertile eggs set in both seasons of the year.

TABLE 2—Detailed hatchability records of two additional pens, "A" and "B", if hens had been selected at "random"(a) in advance of the hatching season

PEN A

Hen number	Early hatches			Late hatches		
	Fertile eggs	Number hatched	Percent hatch	Fertile eggs	Number hatched	Percent hatch
1	17	12	71	5	3	60
2	1	0	0	8	5	63
3	13	5	38	26	22	85
4	14	12	86	11	11	100
5	5	5	100	3	3	100
6	8	6	75	4	3	75
7	3	3	100	2	1	50
8	3	3	100	22	22	100
9	2	2	100	22	19	86
10	6	6	100	10	8	80
Totals	72	54	77 Average	113	97	80 Average
	Average from totals 75			Average from totals 86		

TABLE 2—Concluded

PEN B

Hen number	Early hatches			Late hatches		
	Fertile eggs	Number hatched	Percent hatch	Fertile eggs	Number hatched	Percent hatch
11	9	6	67	19	15	79
12	5	5	100	3	1	33
13	14	12	86	4	4	100
14	2	2	100	15	15	100
15	9	5	56	12	10	83
16	7	7	100	7	7	100
17	8	7	88	10	10	100
18	9	9	100	6	6	100
19	2	2	100	15	14	93
20	9	8	89	7	7	100
Totals	74	65	88 Average	98	89	89 Average
	Average from totals 89			Average from totals 91		

(*a*) This illustrates the kind of individual variability in hatching performance that is commonly obscured in pooled pen records.

cent in Table 2A (if the hen with a single egg is ignored). A single egg would be unimportant, of course, in a lot average but it would be important if the mean of each individual hen were used as a variant instead of an individual egg. The use of the hen as a variant can be justified because of the matroclinous tendency of hatchability.[4]

[4]Henderson, E. W. (1957). Hatching power of purebred versus crossbred chick embryos. Mich. Agr. Expt. Sta. Quart. Bul. 39(4): 570-577.

TABLE 3(a)—Sum of hatching performances of 100 individual hens each set at two seasons of the same year

Fertile eggs	Number hatched	Number not hatched	Percent hatched	Fertile eggs	Number hatched	Number not hatched	Percent hatched
1,193	1,031	162	86	1,081	965	116	89(*b*)
Totals				2,274	1,996	278	87.77

(*a*) Detailed individual hatching records consolidated to save space.
(*b*) Significant Chi Square if computed from totals = 4.20 (1 D/F), biologically invalid. Non-significant Chi Square from 100 differences = 21. (100 D/F), Valid Method.

A More Valid Method with Small Samples

The data in Table 3 were analyzed statistically by comparing the variation in hatching power within individual hens between seasons by the Chi Square method. The mean between seasons was used to compute the "expected" for each hen.

Individual hen Chi Squares were then used as samples of Chi Square to make up the total of "100 degrees of freedom." Since the usual Chi Square table is limited to thirty D/F, the method of Fisher (1930) was followed in the computation which established that the differences between seasons were not significant.

There was a correlation of hatching power between seasons, within hens, of .25 which was very close to significance at the 1 percent point for 98 D/F.

SUMMARY

The results of two methods of sampling of breeding stock for production of hatching eggs for comparing early (mid-winter) and late spring (May and June) hatches were demonstrated.

In the first sample, ten lots of ten hens were selected at random from the flock records of Michigan Agricultural Experimental Station Project 266. Random selection placed no restriction on numbers of eggs set in either season. This procedure simulated the common "random" method of choosing lots of hens for test purposes. Detailed individual hatching data were then recorded to demonstrate hidden bias that could result from such a random selection method.

In order to permit statistical analysis, another sample of 100 hens was chosen at random from the flock with the restriction that each hen must have had a minimum of five fertile eggs set in each season.

Sampling methods designed to avoid bias and biometric methods appropriate for small restricted samples were demonstrated.

Individually pedigreed hens of proved merit are recommended for testing the influence of refined chemical compounds or trace elements on hatching power.

SUGAR BEET-TOP SILAGE EFFECTS ON MILK FLAVOR

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FRESH AND CURED SUGAR BEET TOPS are known to cause disagreeable flavors in milk when fed to cows in large quantities or shortly before milking. The off-flavors are listed by Trout and Taylor (1935) as "neutralizer," "baking soda," "sweetened," "very disagreeable," "strong," "acrid," and "very feedy." Cranfield and Mackintosh (1935) described the off-flavors as "fishy" and in mild cases "musty" and "egg-like." The fishy flavor appeared after the milk was kept a few hours.

Davies (1936) found that betaine in sugar beets is converted to trimethylamine oxide, resulting in fishy flavor as milk is stored. The severity of beet-top off-flavor increased with the amount of betaine-bearing feeds which cows consumed. Cranfield and Mackintosh (1935) as well as Davies (1936) reported that 9 pounds of beet pulp, equally divided for morning and night feeding, could be fed daily without producing off-flavor. Davies further showed that 9 pounds of beet pulp equaled 60 pounds of beet tops in the production of off-flavor in milk. Trout and Taylor (1935) reported that beet top flavor occurred in milk when fed in excess of 25 pounds. The crown of sugar beets contains an accumulation of salts which interfere with crystallization in the recovery of sugar and is, therefore, cut off with the tops.

The salts have cathartic property, causing scours in animals. This property is reported to be largely corrected in the fermentation process in the silo (U.S.D.A., 1919).

While considerable research study has been published about the undesirable flavor resulting from the feeding of fresh and cured beet tops, only Steensberg (1933) has reported on the effect of ensiled beet products on the flavor of milk. Steensberg found that ensiled pulp, fed 2 to 3 hours before milking, had undesirable feed flavor, while

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"morning milk, milked before feeding with beet pulp, was practically uninfluenced." With the feeding of beet-top silage of good quality and free of earth and sand, no "considerable influence of the fodder" was noticed on the odor and flavor of milk.

During a study of sugar beet-top silage for dairy cows (1958) this companion study was made to observe the effect on milk flavor when feeding large quantities of sugar beet-top silage, harvested to be clean and free of earth and sand, and ensilaged with 200 pounds beet pulp per ton.

EXPERIMENT

Three trials were conducted in which six cows were each fed 86 pounds of sugar beet-top silage and 6 pounds of alfalfa hay daily. The beet-top silage contained 200 pounds of beet pulp per ton. However, the crown was removed during harvesting of the beet. The daily roughage ration was equally divided for morning and evening feeding. When evening samples of milk were taken, the cows were fed approximately 1½ hours before milking. When morning samples of milk were taken, the roughage was fed shortly after the evening milking. One-quart samples of milk were taken directly from the milking machine pail for flavor scoring. All the samples were pasteurized by placing the bottles of milk in a water bath where the milk was heated to 143° and 144° F. and held 30 minutes before cooling.

The milk was critically examined for flavor defect and scored by an experienced milk judge using the American Dairy Science Association score card. All samples were scored without the scorer knowing the history of samples and with the experimental samples scored among other regularly scored producer samples. The morning samples were scored 6, 30, and 54 hours after the milk was drawn from the cows. The evening samples were scored 18, 42, and 66 hours after the milk was drawn.

RESULTS AND DISCUSSION

The results of feeding 43 pounds of sugar beet-top silage 1½ hours before the evening milking and 43 pounds approximately 10 hours before the morning milking on the flavor score of milk, are shown in Table 1. When the experimental cows were fed their silage ration 1½ hours before milking, strong feed flavors were found in

most of the samples shown with 12 of 18 samples having 34 to 36 flavor score. This situation is not peculiar to the influence of beet-top silage, however. Similarly strong feed flavors occur from the feeding of many other roughages when fed shortly before milking, as shown by Gamble and Kelly (1922).

The morning milk had exceptionally fine flavor. In this group 13 of 18 samples had scores of 40, which is considered excellent. Two other samples were scored 39 and were criticized for having "feed" flavor. This quality milk is regarded as very good in flavor quality. Cow T15 gave milk that was abnormal, being salty and rancid, conditions which were not due to feed.

No flavors were found that are normally associated with the feeding of fresh or cured beet tops or with the decomposition of betaine to trimethylamine oxide. The flavors found were stable with respect to not becoming fishy during storage, a characteristic of milk when much smaller quantities of fresh beet top or beet pulp are fed.

It is likely that betaine is partially digested by fermentation in the silo, similarly to the fermentation effect on crystals which cause cathartic effects. The extent of the decomposition of betaine was not measured by this study. However, it is apparently high, since an 86-pound beet top silage ration was not effective in causing typical off-flavors. It is generally considered that a pound of silage is equal to 2 pounds or more of cured beet tops in dry matter. Trout and Taylor (1935) found that 25 pounds, fed daily, of cured beet tops produced the typical off-flavors.

What effect the removal of the beet crown may have on preventing typical beet-top flavors from appearing in milk is not known.

SUMMARY AND CONCLUSIONS

Beet-top silage of good quality may be fed to milking cows in an 86-pound daily quantity without producing flavors that are associated with betaine or trimethylamine oxide. It is suggested that betaine is fermented in the silo and reduced to products that are not capable of causing the typical beet-top kind of off-flavors.

When beet-top silage was fed shortly before milking, strong feed flavors were found in milk; when fed directly after milking, excellent, feed-free milk was produced.

TABLE 1—The effect of the time of feeding sugar beet-top silage upon the flavor of milk

Cow number	The flavor score(*a*) of					
	Evening(*b*) milk at various tasting periods after milking			Morning(*c*) milk at various tasting periods after milking		
	18 hr.	42 hr.	66 hr.	6 hr.	30 hr.	54 hr.
Trial 1						
A110	34 F(*d*)	34 F	34 F	40	40	40
T 15	36 SF	36 SF	36 SF	37 S	37 S	36 S
T 66	38 F	38 F	38 F	40	40	40
A 80	38.5 F	38 F	38 F	40	40	40
K218	35 F	34 F	35 F	40	39.5	36
A 76	34 F	35 F	35 F	40	40	40
Trial 2						
A110	37 F	37 F	36 F	40	40	39
T 15	35 SF	35 SF	35 SF	36 S	36 S	36 S
T 66	36 F	36 F	36 F	40	40	40
A 80	34 F	34 F	34 F	40	40	40
K218	34 F	34 F	34 F	40	40	40
A 76	35 F	35 F	35 F	40	40	40
Trial 3						
A110	34 F	34 F	34 F	39	39	37
T 15	37 SF	37 SF	37 SF	32 RS	32 RS	32 RS
T 66	34 F	34 F	34 F	40	40	40
A 80	34 F	34 F	34 F	39 F	39 F	38.5 F
K218	39 F	39 F	39 F	40	40	40
A 76	39 F	39 F	39 F	40	40	39.5

(*a*) Key: 40-45 Excellent flavor, no criticism
39-39.5 Very good, very slight flavor defect
37-39 Good, slight flavor defect
35-37 Fair quality, definite flavor defects
30-35 Poor quality, strong flavor defects.
(*b*) Cows fed 1½ hours before milking began.
(*c*) Cows fed 10 hours before milking began.
(*d*) Key to letters:
F = feed flavor
S = salty flavor
R = rancid flavor.

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THE INHERITANCE OF IMPERFECT ALBINISM IN THE FOWL

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IN THE SPRING OF 1954, six day-old, non-pedigreed S. C. White Leghorn chicks, exhibiting a pink-eyed condition, were submitted to us for study by a Michigan commercial hatcheryman. The chicks had been hatched from eggs obtained from a supply flock owner. Previous to the finding of these particular chicks, no similar individuals had appeared. Each chick displayed light-sensitivity characteristic of albinos and, in addition, exhibited a short-downed condition over their entire body, particularly in the cephalic and wing areas. Carotenoid pigments were present in the skin, beak, and shanks. Four of the chicks were reared to maturity and were pullets.

To determine whether or not this apparent mutation was similar to the recessive autosomal albinism, *a*, reported by Warren (1933) or to the sex-linked recessive imperfect albinism, *al*, reported by Mueller and Hutt (1941) and Hutt and Mueller (1943), matings designed to determine the mode of inheritance of this characteristic were initiated. To date, very few cases of albinism in the domestic fowl have been reported.

Matings and Results

In the spring of 1955, the four albino pullets were mated to a normal S. C. White Leghorn male from the station production flock. A total of 88 F_1 chicks were hatched, and 30 embryos were examined. All chicks and embryos were phenotypically normal and had typical length Leghorn down. The chicks were reared on wire bottom battery brooders to 8 weeks of age, at which time they were transferred to the range with other station birds. Mortality during the brooding and growing period did not differ materially from that of other stocks. The sex ratio of the F_1 chicks was 47 males to 41 females.

ARTICLE 41-29

During 1956, F_1 individuals were mated *inter se*. In addition, an F_1 male was (1) backcrossed to the one remaining original albino female, (2) mated with four New Hampshire pullets, and (3) mated to F_1 females. The segregating progenies are presented in Table 1.

TABLE 1—Sex ratios of the progeny obtained from individuals in 1956 matings. Chi-square based upon expected sex ratios if albinism were due to a sex-linked recessive gene

Mating	Number of dams	Number normal males	Number normal females	Number albino males	Number albino females	X^2	P(*a*)
F_1 x F_1	11	178	91	0	75	.419	.52
Embryos (F_2)		41	19	0	18		
F_1 x N. H.(*b*)	4	38	17	0	14	.710	.42
F_1 x Albino	1	10	9	9	7	.258	.87

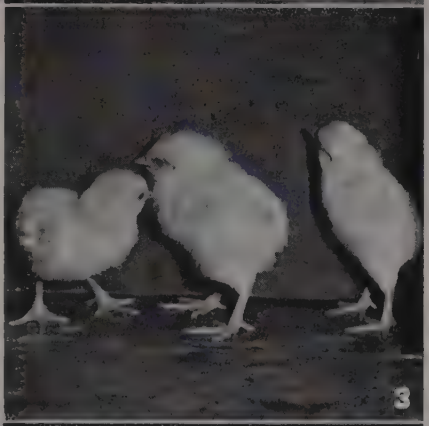
(*a*) N = 3.
(*b*) N. H. = New Hampshire.

As shown in Table 1, the F_2 ratio of normal to albino chicks was the same as the ratio obtained when an F_1 male was outcrossed to New Hampshire females. The F_1 females do not carry the sex-linked gene and therefore the expected ratio of 2 normal males : 0 albinotic males : 1 normal female : 1 albinotic female, was obtained. Therefore, it was clearly demonstrated that this apparent mutation was due to a simple sex-linked, recessive factor difference between the normal and albino individuals. F_1 carrier males, normal in appearance, passed the mutation to half of their daughters and also to half of their sons, but the latter showed no trace of albinism.

The individuals in the backcross mating produced the first homozygous males, and the expected ratio of 1 normal male : 1 albino male : 1 normal female : 1 albino female, was realized (P = 0.87, Table 1).

Since the female fowl is the heterogametic sex, the critical mating to verify the hypothesis that a sex-linked factor was responsible for the albinism observed are those where the female parent is normal and the male parent is albinotic. All male offspring should be normal and all female offspring should be albinotic.

To demonstrate the foregoing, 1956-hatched albino males were (1) backcrossed to F_1 normal females and (2) outcrossed to New Hampshire females. Further, albinos were mated *inter se*. To cross-check



Figs. 1-5. (1) Day-old albino chicks. (2) Day-old normal chick (left) and albino chick (right). (3) Day-old normal chick (center) albino chicks (left and right). Note short down on albinos. (4) Normal pullet. (5) Albino pullet.

previous results for repeatability, F_1 individuals were again: (1) backcrossed to albino females, (2) mated *inter se*, and (3) mated with New Hampshire females. The results are recorded in Table 2.

From the individuals in the albino male x normal female matings involving 15 dams and two sire families, a total of 368 chicks and embryos were observed, of which 196 offspring were males (all normal), and 172 were females (all albinotic). The ratio did not depart significantly from the theoretical expectation of 1 normal male : 1 albino female, ($P = 0.67$).

From the individuals in the reciprocal matings, i.e., F_1 males on albino females, approximately equal numbers of normal and albino backcross progeny were observed—43 normals : 39 albinos (Table 2). In this segregating population, the theoretical phenotypic ratio of 1 normal male : 1 albino male : 1 normal female : 1 albino female, was realized, ($P = 0.26$). The frequencies of the four possible phenotypes in the segregating population are shown in Table 2.

The matings of albinotic individuals *inter se* produced only albino

TABLE 2—Frequency of segregating phenotypes, 1957 matings. Chi-square based upon expected sex ratios if albinism were due to a simple sex-linked recessive gene

Mating	Number of dams	Number normal males	Number normal females	Number albino males	Number albino females	X^2	P(*a*)
Albino x F_1 & N.H.(*b*)	8	89	0	0	65	3.740	.29
Albino x F_1 & N.H. ..	7	107	0	0	107		.99
Total.....	15	196	0	0	172		
F_1 x Albino.....	8	27	16	18	21	4.049	.26
Albino x Albino.....	8	0	0	124	111		.99
F_1 x F_1.....	3	48	19	0	15	2.780	.42
F_1 x F_1.....	9	87	39	0	42	.321	.95
F_1 x F_1.....	7	27	20	0	12	2.593	.44
Total.....	19	162	78	0	69	1.252	.74
F_1 x N.H.....	4	60	29	0	29	.024	.99
Total.....	23	222	107	0	98	1.056	.79

(*a*) N = 3.
(*b*) N. H. = New Hampshire.

chicks and embryos. Although there may appear to be somewhat of an excess of albino males over albino females (124:111) from the individuals in the albino x albino matings, the deviations from expected sex ratios were not significant, ($P = 0.41$).

The repeatability trial of F_1 x F_1 matings involved 19 dams and 3 sire families. A total of 309 chicks and embryos were observed of which 240 were normal and 69 were albino. The number of F_2 individuals falling into the various phenotypic classes were: 162 normal males : 78 normal females : 69 albino females. No male albino segregates were found. The observed F_2 ratio for a simple sex-linked recessive gene is a close fit ($P = 0.74$) to the expectation of 2 normal males : 0 albino males : 1 normal female : 1 albino female. The ratio of normal to albino progeny produced by New Hampshire females mated with F_1 carrier males should also fit this expectation if the recessive gene for albinism is located on the sex chromosome. The numbers of offspring segregating into the same classes did not differ significantly from that obtained in the F_2 segregating population as shown by the remarkable fit, ($P = 0.99$). Together, these data provide evidence that the deviations from ratios expected for a sex-linked recessive gene are not significant.

It was not possible to obtain progeny from the original mutated stock to actually determine whether this albinotic condition was a repeat mutation (Hutt, 1958). It is therefore suggested that this genetic condition is an independent mutation yet apparently identical to the simple sex-linked recessive imperfect albinism symbolically designated as *al* reported by Mueller and Hutt (1941).

Histological

Histological retinal cross sections through the posterior part of the eye of normal chicks showed that melanic pigment was very intense in the pigment epithelium whereas, in the eyes of albinotic chicks, pigment was absent in this area, (Figs. 6 and 7). Mueller and Hutt (1941) observed scanty pigmentation in the pigment epithelium of albino eyes. Further, these researchers found melanic pigment present in the choroid layer or coat of the eyes of normal chicks. In contrast to their findings, our studies of numerous histological sections of normal eyes showed that the choroid was devoid of pigment. The choroid in our normal chickens appeared like the albinotic choroid described by Mueller and Hutt (1941).

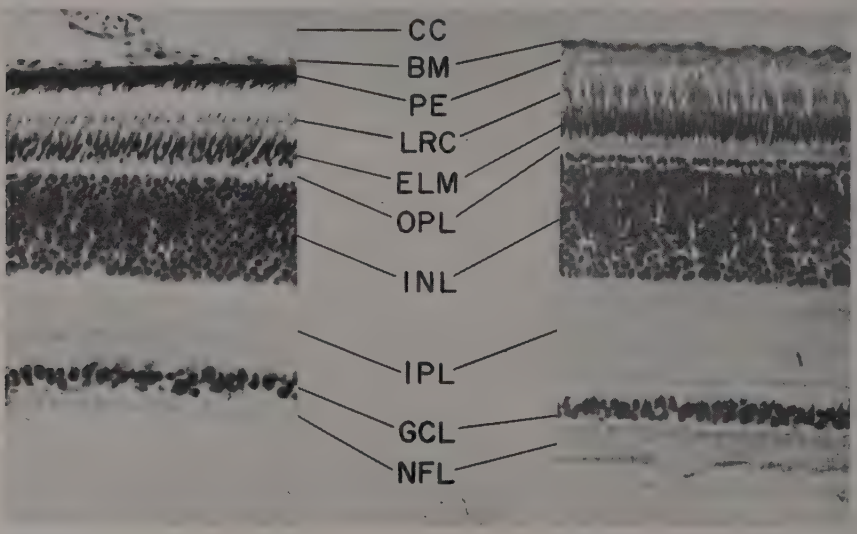


Fig. 6 Fig. 7

CC — Portion of choroid coat
BM — Bruch's membrane
PE — Pigment epithelium
LRC — Layer of rods and cones
ELM — External limiting membrane
OPL — Outer plexiform layer
INL — Inner nuclear layer
IPL — Inner plexiform layer
GCL — Ganglion cell layer
NFL — Nerve fiber layer

Figs. 6 and 7. Photomicrographs of retinal cross sections through the posterior part of the eyes of a day-old normal chick (left) and an albino chick (right). Pigment epithelium of normal chick is intensely pigmented; that of the albino chick shows absence of melanic pigment. X250.

The photomicrographs of the retinal cross sections of the albino eyes presented herein, appear (in black and white) to show melanic pigment in reduced amounts in the layer of rods and cones, inner nuclear layer, and ganglion cell layer, as may be seen in Figs. 6 and 7. However, this is due to basophilic staining granules. Careful microscopic examinations of the eyes of several chickens showed that these areas were definitely not pigmented.

Figs. 8 and 9 show sections of the iris, ciliary body, and lens capsules of day-old normal and albino chicks. It is notable that there is a prominent pigmentation layer in the ciliary body of the normal, in contrast to the scanty pigmentation in this area of the albino eye. Pigment was found diffusely in the pecten of the normal and absent in the albino eye, although not shown in the photomicrographs.

In view of the fact that Mueller and Hutt (1941) show distinct

pigmentation in the choroid layer of the eyes of normal chicks, and our studies of a number of normal chicks failed to show pigmented choroid, it is suggested that additional studies of normal chick retinae may throw further light on this particular point. Possibly the dominant white gene *I* may exert an influence on choroid pigmentation.

This histological condition of limited quantities of melanin in the ciliary processes and in the posterior part of the iris is quite similar to the imperfect albinism in Bronze turkeys reported by Hutt and Mueller, (1942), but differs genetically in that it was not lethal nor did it cause blindness in the albino chickens studied.

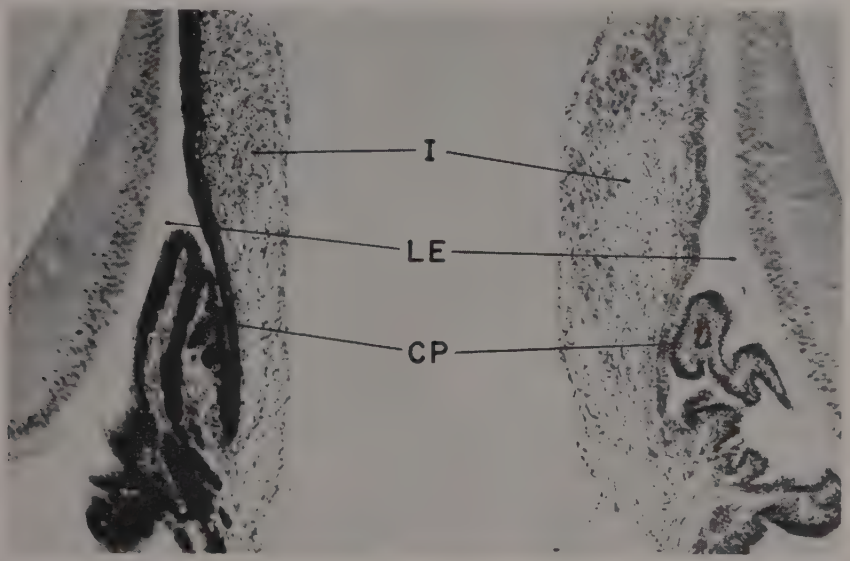


Fig. 8 Fig. 9

I — Iris
LE — Lens epithelium
CP — Ciliary process

Figs. 8 and 9. Photomicrographs of sections of the iris, ciliary body, and lens capsule of the eyes of a day-old normal chick (left) and an albino chick (right). Melanin is intense in the ciliary processes and iris of the normal chick and in subnormal quantities in the albino chick. X130.

Other Gene Effects

There was no evidence that the albinism studied was associated with differential embryonic mortality, brooding mortality, adult vi-

ability, or productivity. Hatchability was uniformly high in all stocks. That differential embryonic mortality was not encountered is shown, in part, by the sex ratios among hatched chicks (Tables 1 and 2). Brooding mortality to 6 or 8 weeks of age was 3.15 percent for the normals and 3.51 percent for the albinos. Viability of the albino adults was comparable to that of station production stocks. Further, the egg production of the F_1 and albino females was similar to that of non-related S. C. White Leghorn stocks. All albinotic chicks were brooded in floor pens, reared on range, and housed as adults in floor pens, intermingled.

SUMMARY

Matings were made to determine the mode of inheritance of a pink-eyed condition which appeared in day-old S. C. White Leghorn chicks submitted to us by a Michigan hatcheryman. Carotenoid pigments were present in the skin, beak, and shanks of the pink-eyed chicks. Associated with this imperfect albinism was a short-downed condition.

The matings, number of chicks in the segregating populations, and the corresponding probabilities are presented. The data agreed closely with the expectations for segregation of a simple sex-linked recessive gene.

Photomicrographs of retinal cross sections showed an absence of melanic pigment in the pigment epithelium of the albinotic chicks, as compared with intense pigmentation of the eyes of normal chicks in this particular area. Prominent pigmentation layers were evident in the ciliary body of the normal eye, in contrast with very limited pigmentation in this area of the eye of albinos. In contrast with previously reported findings by other researchers, the choroid layer of the eyes of the normal chicks used in this study was devoid of pigmentation. Pecten was present diffusely in the normal eye and absent in the albinotic eye.

There was no evidence to indicate that the imperfect albinism studied was associated with differential embryonic mortality, brooding, rearing, or adult mortality or productivity.

The pink-eyed condition studied apparently arose as an independent mutation and was caused by a simple sex-linked recessive gene. It is suggested that this gene is identical to the *al* gene previously reported.

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ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. M. Lois Calhoun, head, anatomy department, College of Veterinary Medicine, for the preparations of the histological sections and photomicrographs, and to Mr. P. G. Coleman, photo assistant, information services, for his assistance in obtaining the prints for Figs. 1-5.

JOURNAL ARTICLE ABSTRACTS

Production of Sugar Beet Hybrids

Kohls, H. L.

Proc. Amer Soc. of Sugar Beet Tech., pp. 103-107. 1955. (Journal Article 1741 from the Michigan Agricultural Experiment Station)

Data are presented which suggest that sugar beet breeding is still in the mass selection stage, and that controlled hybridization offers greater possibilities to increase yields than mass selection. Several high-yielding hybrids have been produced but do not have sufficient black root resistance for commercial use. Greater emphasis is now being placed on developing disease-resistant, male-sterile strains for use in new hybrids.

Thyroid Circulation in the Rabbit Including Arteriovenous Difference

Monkus, E. F., and E. P. Reineke

The Amer. Jour. of Physiology 192:268-272. 1958. (Journal Article 1783 from the Michigan Agricultural Experiment Station)

Thyroidal I-131 clearance and arteriovenous (AV) difference, together with urinary excretion of I-131, were determined in 19 rabbits maintained for varying periods on a low iodine diet. Absolute blood flow was computed by dividing thyroidal I-131 clearance by AV difference. Thyroid cell heights were measured as an independent index of thyroid status. The rabbits were divided into two distinct groups on the basis of acinar cell heights: Group I with mean cell heights of 4.1 to 5.2 micra and Group II with mean cell heights of 6.9 to 8.9 micra.

Group I had a mean clearance of .43 gm. blood/min. and a mean thyroid/urinary (T/U) ratio for I-131 of 3.1. The mean AV difference was 25 percent. Absolute and relative blood flows averaged 2.0 gm./min. and 6.1 gm./min./gm. thyroid, respectively.

Group II had a T/U ratio of 40 and mean clearance of 4.3 gm./min. Mean AV difference was increased to 57 percent. Absolute and relative blood flows averaged 7.9 gm./min. and 21 gm./min./gm. thyroid, respectively. All of the indices listed were significantly higher ($P = 0.02$) in Group II than in Group I.

Absolute thyroid circulation was significantly correlated with T/U ratio ($r = .87$), relative thyroid circulation was not. Relative blood flow was significantly correlated with mean acinar cell height ($r = .68$), but absolute blood flow was not. It is suggested that the high circulation rate observed in the thyroid is needed because of large requirement for iodide relative to its concentration in the blood.

The Post-Emergence Application of Herbicides to Tomatoes at Different Times and Locations

Ries, S. K., and B. H. Grigsby

Proc. NCWCC. pp. 55-56. 1955. (Journal Article 1856 from the Michigan Agricultural Experiment Station)

Tomatoes of the variety Rutgers were treated with Natrin, Methin, and CMU, each at two rates. The tomatoes were treated after transplanting and at

lay-by. Identical experiments were carried out at East Lansing and at the Southwestern Michigan Experimental Farm. Yields, weed control, and growth ratings indicated that Natrin and Methin applied at lay-by in southwestern Michigan caused severe injury at both rates of application.

Addition of Sugar, Amino Acids, and Corn Steep Liquor to Cucumber Fermentation

RAGHEB, H. S., AND F. W. FABIAN

Applied Microbiol. 5:253-261. 1957. (Journal Article 1877 from the Michigan Agricultural Experiment Station)

Results are reported on a 2-year study of the influence of added sucrose, cystine, tryptophane, and or corn steep liquor on cucumber fermentations. The corn steep liquor treatment resulted in the development of somewhat higher counts of acid-forming bacteria and higher total acidities than observed in corresponding controls. This was not due to the addition of fermentable sugar or cystine and tryptophane since the addition of these compounds, either singly or in combination, had no pronounced effect.

Nutritive Value of Sunchoke Silage for Milk Production

DEXTER, S. T.; C. W. DUNCAN, AND C. F. HUFFMAN

Agronomy Jour. 49:336-338. 1957. (Journal Article 1928 from the Michigan Agricultural Experiment Station)

A cross of the common sunflower and the Jerusalem artichoke has been called "sunchoke." This vigorous perennial sunflower seemed a possible source of silage for Michigan. After the tubers were well formed, the stalks were harvested with a field chopper for a palatable silage. This was fed in comparison with corn silage to dairy cattle. Milk production, body weight changes and coefficients of digestibility were determined. Coefficients of digestibility and milk production were lower with sunchoke than with corn silage, but body weight changes seemed the same. From other experiments with sunflowers, it seems likely that earlier harvest of the sunchokes would have been advantageous.

Effect of Foliar Application of Substituted Benzoic Acid on Leaf Development in *Zinnia Elegans*

APPLEGATE, H. G., AND C. L. HAMNER

New Phytologist 56:301-304. 1957. (Journal Article 1984 from the Michigan Agricultural Experiment Station)

Profound morphological changes were induced in Zinnia elegans by several of the treatments with substituted benzoic acids. The primary effect of substituted benzoic acids on leaf histogenesis of Zinnia elegans is a stimulation of vascular tissue differentiation at all concentrations used. At low concentrations of substituted benzoic acids parenchymous tissues are induced to remain meristematic. At high concentrations of substituted benzoic acids parenchymous tissues are undifferentiated or unexpanded.

The Use of Low Level Piperazine on Pigs Naturally Infected with *Ascaris Lumbricoides*

LINDQUIST, W. D.

Am. Jour. of Vet. Res. 18:508-510. 1957. (Journal Article 1992 from the Michigan Agricultural Experiment Station)

Young pigs were given one-fifth of a therapeutic dose of polymeric piperazine-1-carbothioic acid (Parvex-Upjohn Co.) per day in the feed 1 week prior to infection and during the course of infection with *Ascaris lumbricoides.* This medication did not prevent the migratory phase of the infection, as evidenced by liver scarring, nor did it completely remove the larvae from the digestive tract of five experimental pigs. The effect on mature worms of continuous feeding of this level of the compound was not determined.

Observations on the Nutritional Requirements of *Bacillus Coagulans*

HUMPHREYS, T. W., AND R. N. COSTILOW

Canadian Jour. of Microbiol. 3:533-541. 1957. (Journal Article 2006 from the Michigan Agricultural Experiment Station)

The nutritional requirements of 14 cultures of *Bacillus coagulans,* which were isolated and identified in this laboratory, and eight other authentic strains of this organism, were studied at 37° C. Biotin and thiamin were required by all strains in a semi-synthetic medium containing enzymatic casein hydrolysate, glucose, and mineral salts. In addition, one strain required niacin. An additional requirement for folic acid or para-aminobenzoic acid was noted for most strains in a synthetic medium. With few exceptions, the amino acid requirements were non-specific. Glutamic acid appeared essential for a few strains and stimulated others.

The Effect of 2, 4-Dichlorophenoxyacetic Acid on the Accumulation of Mineral Elements in Tobacco Plants

WILDON, C. E.; C. L. HAMNER, AND S. T. BASS

Plant Physiol. 32:243-244. 1957. (Journal Article 2009 from the Michigan Agricultural Experiment Station)

Fifty ml. of a .1 percent solution of sodium salt of 2,4-D was poured into the sand around young tobacco plants grown in sand in eight-inch pots. Two weeks later, plants were harvested, dried, and analyzed for mineral elements.

Contents of phosphorus and potassium in the tops of treated plants were much less than in the tops of untreated plants.

Calcium accumulated to greater amounts in roots than in tops of treated plants, but there was no difference in accumulation of calcium in roots and tops of untreated plants.

Factors Affecting Development of Bacterial Stem Rot of Pelargonium

KIVILAAN, A., AND R. P. SCHEFFER

Phytopathol. 48:185-191. 1958. (Journal Article 2028 from the Michigan Agricultural Experiment Station)

A high percentage of commercially available Pelargonium stocks carry *Xanthomonas pelargonii* in a latent form. Twenty-six percent of 600 plants of

six varieties, kept under conditions favoring disease development but precluding disease spread, developed stem rot within 3 months. *X. pelargonii* did not attack plants outside the Geranium family. Strains of the causal organism were found to differ in quality and quantity in effects on host plants. The pathogen was isolated from vessels of inoculated plants, but caused stem rot only when parenchyma was invaded. Root invasion was demonstrated. Disease was favored by high temperatures: symptoms were almost absent at 10° C. night temperature, developed slowly at 21° C., and rapidly killed plants at 27° C. Mineral nutrient levels below and above optimum for growth enhanced disease development, as did high N, high P, and low Ca. Symptoms were inhibited by high K, low P, high Ca, and balanced nutrient solution at optimum concentrations for growth.

The Effect of Fertilizer Application and Tillage on Sugar Beet Yields

KENEFICK, D. G.; C M. HARRISON, AND G. E. NICHOL

Proc. Am. Soc. of Sugar Beet Tech. 9:115-117. 1957. (Journal Article 2029 from the Michgan Agricultural Experiment Station)

Fertilizer was applied to a Kawkawlin loam, where alfalfa was plowed under, at the following total amounts of N, P_2O_5, and K_2O per acre: Check (no fertilizer), 10-40-40, 130-160-160, 10-140-140, 10-300-300 and 130-350-350. Sugar beets yielded 9.67, 12.03, 13.12, 13.57, 14.87, and 15.27 tons per acre, respectively. Beets following alfalfa yielded as well where 10 pounds of nitrogen were added as where 130 pounds were applied.

Sugar beets harvested in 1956 showed significant responses to a previous fertilizer application of 800 and 1,600 pounds per acre applied to a forage seeding in 1950.

Minimum, moderate and maximum packing of the seedbed, combined with subsoiling at 12 and 18 inches showed no difference in sugar beet yields. A masking effect caused by previous fertilizer treatments on the land, plus the effects of the alfalfa sod and a low amount of rainfall during the growing season all combined to balance out any differences caused by tillage techniques.

The Fat-Globule Membrane of Normal Cows Milk. I. The Isolation and Characteristics of Two Membrane-Protein Fractions

HERALD, C. T., AND J. R. BRUNNER

Jour. of Dairy Sci. 40:948-956. 1957. (Journal Article 2037 from the Michigan Agricultural Experiment Station)

A cold (0 to –5° C.), 35 percent ethanol in ether mixture was found to be a satisfactory cleavage agent for the lipoprotein complex of the fat-globule membrane.

The fat-globule protein(s) consist of two fractions of approximately equal distribution based upon their solubility in .02 *M* sodium chloride solution. The "soluble" fraction was readily soluble in aqueous solvents, whereas the "insoluble" fraction required strong reducing agents, such as those commonly used to attack disulfide linkages, or detergents to effect solution. The successful solubilization of the insoluble protein fraction makes it possible to explore further the physical and chemical nature of the fat-globule membrane.

The soluble white protein fraction contained 11.10 percent nitrogen, .7 percent nitrogen, .7 percent sulfur, .46 percent phosphorus and 7.06 percent ash.

Aqueous solutions of this protein gave a strongly positive Molisch test, reduced Fehling's solution slightly, and was nitroprusside negative after heating to 75° C.

The insoluble reddish-brown fraction contained 13.8 percent nitrogen, .94 percent sulfur, .23 percent phosphorus, 2.08 percent ash. Aqueous suspensions of this fraction were Molisch negative and nitroprusside positive upon momentary heating to 75° C.

Alkaline phosphatase and xanthine oxidase activity determinations showed a concentration of phosphatase in the soluble fraction and xanthine oxidase in the insoluble fraction.

The insoluble fraction was tentatively classified as a pseudokeratin on the basis of a) insolubility in .02 *M* sodium chloride solution; b) reactivity to agents commonly employed to disrupt disulfide linkages; c) affinity for alkaline solution; and d) a 1:1 ratio of lysine to arginine.

Bovine Re-Entrant Duodenal Fistula Studies. 1. Establishment of Re-Entrant Duodenal Fistula

CONNER, H. G.; A. DARE MCGILLIARD, AND C. F. HUFFMAN

Jour. of Animal Sci. 16:692-697. 1957. (Journal Article 2041 from the Michigan Agricultural Experiment Station)

A re-entrant duodenal fistula was established in order to gain a better insight into the role of the digestive tract of ruminant nutrition. This technique made possible the quantitative sampling of a continuously moving system without upsetting normal physiologic relationships. A Holstein steer weighing about 500 lbs. was used. The duodenum was transacted 5 inches from prylorus. Stainless steel cannulae were inserted in both stumps. The surgical methods used were described. The exposed ends of the cannulae which protruded 1½ inches and which were 4 inches apart were connected by a V-shaped piece of glass tubing of the same bore. The glass tube was later replaced by a clear plexiglas tube with flexible plastic couplings. This made possible the continuous collection, weighing, and sampling of the digestive tract ingesta passing from the fore stomachs and the continuous return of the ingesta.

Mint Production on the Organic Soils in Michigan

DAVIS, J. F.; R. E. LUCAS, AND L. N. SHEPHERD

Better Crops With Plant Food 61:28-36. 1957. (Journal Article 2047 from the Michigan Agricultural Experiment Station)

Factors affecting the production of mint on organic soils are discussed. Included are recommendations for planting. use of fertilizer, minor elements, soil and tissue tests, watertable, transplanting versus planting of roots, rotations, tillage and cultivation, harvesting, and oil quality. Spearmint *(Mentha spicata)* and peppermint *(Mentha peperita)* are the kinds grown.

Excessive applications of K may reduce yields. Nitrogen may increase yield particularly when the soil is cold and wet and drainage is only fair. Minor elements are relatively unimportant. Four pounds of copper per acre is usually recommended on soils with pH below 5.5 and occasionally 10 to 20 pounds of manganese per acre may increase the yield of spearmint. Minimum tillage methods are recommended.

Wilt is a serious disease. Mint grown 2 out of 4 years at the M.S.U. Muck Experimental Farm became badly infested with the disease so that yields were not profitable.

Experimental Leptospirosis III. Caprine *Leptospira pomona* Infection

MORSE, E. V., AND R. F. LANGHAM

Jour. of Vet. Res. 19:139-144. 1958. (Journal Article 2053 from the Michigan Agricultural Experiment Station)

The course of *L. pomona* infection in goats appears to be inapparent. Gross pathological changes are minimal and are observed only in kidneys. The kidneys on gross examination contained scattered greyish-white foci which on section extended through the depth of the cortex and occasionally into the medulla. The renal lesions consisted of foci of lymphocytes, plasma cells, and a few macrophages. The brains of three goats showed meningitic and encephalitic lesions. The urine may contain tremendous numbers of leptospiras for at least 30 days following infection. The kidneys and in some instances the liver or spleen may contain the agent.

Transmission from infected swine to a goat has been established. Therefore, the goat represents a potential source of *L. pomona* infection for susceptible hosts. In areas where the goat population is high, this species should be considered as a reservoir of *L. pomona* infection.

Differences in Thyroid Activity of Several Strains of Mice and F_1 Hybrids

AMIN, A.; C. K. CHAI, AND E. P. REINEKE

Amer. Jour. of Physiol. 191:34-36. 1957. (Journal Article 2055 from the Michigan Agricultural Experiment Station)

The thyroid secretion rate was determined in four strains of inbred mice and two groups of F_1 hybrids. In all genotypes the thyroid secretion rate was consistently but not significantly greater in males than in females. The average thyroid secretion rates, expressed as micrograms L-thyroxine/100 gm. body weight with the standard errors for the males and females, were: A/Jax 2.13 $\pm$0.12 and 1.84 $\pm$0.10; BALB/c 2.44 $\pm$0.21 and 1.84 $\pm$0.12; C57BR/cd 3.35 $\pm$0.34 and 2.45 $\pm$0.11; C57BL/6 4.19 $\pm$0.64 ug. and 3.33 $\pm$0.34. The secretion rate for hybrids CAF_1 and BBF_1 males and females, respectively, were: 2.34 $\pm$0.185 and 1.84 $\pm$0.106; 3.79 $\pm$0.644 and 2.74 $\pm$0.268 ug./100 gm. C57BL strain and BBF_1 hybrid had significantly higher secretion rates than all other groups.

The results are consistent with the output rate values reported earlier by the same authors, and clearly indicate that thyroid activity is under genetic control.

High Level Urea Feeding to Dairy Cattle I. The Effect of High Level Urea Feeding on the Growth and Metabolism of Growing Dairy Heifers Without Sulfur Supplementation

LASSITER, C. A.; R. M. GRIMES; C. W. DUNCAN, AND C. F. HUFFMAN

Jour. of Dairy Sci. 41:281-285. 1958. (Journal Article 2072 from the Michigan Agricultural Experiment Station)

Twenty-four Holstein dairy heifers were used in a 150-day trial to study the effect of feeding grain rations containing 3, 5, and 7 percent urea upon growth,

feed consumption and metabolism. Ground corn cobs were fed as the sole source of roughage.

As the levels of urea in the ration increased, the consumption of corn cobs decreased, although not significantly, and daily gains and feed efficiency decreased significantly. The average daily gain for heifers fed rations containing 3, 5, and 7 percent urea were 1.14, .85 and .64 lb. per day, respectively. The level of urea in the ration did not significantly effect nitrogen retention or blood levels of urea nitrogen, but as the intake of urea increased, blood serum levels of non-protein nitrogen increased significantly, and the levels of serum proteins significantly decreased. The possibility of a sulfur deficiency in a ration containing either 5 or 7 percent urea was discussed.

Sorbic Acid as a Selective Agent in Cucumber Fermentations II. Effect of Sorbic Acid on the Yeast and Lactic Acid Fermentations in Brined Cucumbers

COSTILOW, R. N.; F. M. COUGHLIN; E. K. ROBBINS, AND WEN-TAH HSU

Appl. Microbiol. 5:373-379. 1957. (Journal Article 2074 from the Michgan Agricultural Experiment Station)

Sorbic acid treatments of .01, .025, .05, and .10 percent were tested for their effect on the yeast and lactic acid fermentations in cucumber brines. The 3-year study involved 121 experimental cucumber fermentations distributed among 11 different locations in the northern cucumber production area. All treatments were tested in brine strengths from 5.3 to 10.6 percent salt (NaCl). No appreciable yeast fermentation or pellicle formation was observed in any lot containing at least .025 percent sorbic acid. Yeast growth was greatly delayed by the .01 percent treatment, but relatively high populations of subsurface yeasts and pellicles of surface yeasts developed after an extended time. Acid development was inhibited by .10 percent sorbic acid when the initial brine strength ranged from 20° to 40° salometer (513 to 10.6 percent NaCl); also, it was inhibited by .05 percent sorbic acid with initial brining of 40° salometer. When .03 percent levels or less were used, no significant effect on the acid development was noted.

Toxic Action of Hexavalent Chromium on Large Mouth Bass

FROMM, P. O., AND R. H. SCHIFFMAN

Jour. of Wildlife Mgmt. 22:40-44. 1958. (Journal Article 2088 from the Michigan Agricultural Experiment Station)

The median tolerance limit (TLm) of hexavalent chromium to large-mouth bass was found to be 195 mg. chromium/1 (chromium in water as K_2CrO_4). Exposure to 94 mg. Cr/1 caused initially a slight but not significant increase in the oxygen consumption of bass followed by a gradual decline to 27 percent below normal after 68 hours' exposure. Exposure to chromium caused severe pathological changes in the intestine immediately posterior to the pyloric caeca that in all probability completely destroyed its digestive function. The normal respiratory rhythm of bass was not observably altered following exposure to chromium. However, coughing movements which occurred at fairly regular intervals were observed. No change in the histology of the gill of fish exposed to chromium was noted. In concentrations that are not acutely lethal, chromium apparently does not kill fish by interference with the respiratory function of the gill.

The Yield, Root Distribution, and Potassium Content of Alfalfa and Bromegrass Grown Under Three Levels of Applied Potash in the Greenhouse

LAWTON, K., AND M. B. TESAR

Agronomy Jour. 50:148-151. 1958. (Journal Article 2098 from the Michigan Agricultural Experiment Station)

In greenhouse trials, significant increases in forage production of and K absorption by alfalfa and bromegrass were obtained as the amount of applied K increased. Yield response of forages to fertilizer K was less marked with soil containing a higher quantity of available soil K. Total production of bromegrass was half that of alfalfa, but the quantities of K removed were about equal. The change in several extractable fractions of soil K was directly related to the root distribution pattern of the forage.

Distribution of Proteins in Fresh and Stored Shell Eggs

EVANS, R. J.; J. A. DAVIDSON; D. H. BAUER, AND S. L. BANDEMER

Poult. Sci. 37:81-89. 1958. (Journal Article 2100 from the Michigan Agricultural Experiment Station)

Eggs were obtained from 10 hens kept in laying cages and fed a ration of constant composition. Whites and yolks from fresh, 4-, 8-, and 12-month old eggs were separated and analysed for crude protein. Protein distribution and speed of migration in an electric field of each protein were determined by paper electrophoresis. No transfer of protein from white to yolk occurred during 12 months of cold storage. Protein from the whites of 12-month old eggs contained more of the ovomucoid plus ovoglobulin fraction and less conalbumin and lysozyme than fresh eggs. A large part of the loss of lysozyme occurred in the first 4 months of storage. Ovalbumin from 12-month old eggs contained less ovalbumin A_1 and more A_2, and A_3 than that from fresh eggs. Yolk protein from 12-month old eggs contained less livetin, yolk protein C, and more lipovitellenin than that from fresh eggs. The lipovitellenin from old eggs migrated almost twice as fast as that from fresh eggs.

Experimental Leptospirosis V. Pathology of *Leptospira pomona* Infection in Swine

LANGHAM, R. F.; E. V. MORSE, AND R. L. MORTER

Amer. Jour. of Vet. Res. 19:395-400. 1958. (Journal Article 2101 from the Michigan Agricultural Experiment Station)

Swine are frequently infected (3 to 25 percent in U.S.) with *L. pomona*, which closely resembles the spirochetes. Pigs probably serve as the main source of infection for cattle, horses, sheep, and man. An understanding of the pathological alterations in porcine tissues should enable a better perspective in evaluating and assessing the importance of leptospirosis to the livestock industry and public health areas concerned.

1. The effects of *L. pomona* infection were studied in fifteen swine.
2. Grossly, the kidney had more extensive lesions than any other organ. They consisted of focal grayish-white areas measuring up to 1 centimeter in diameter.
3. The grayish-white areas contained focal accumulations of lymphocytes,

plasma cells and some macrophages. Some of the foci showed connective tissue formation.

4. The proximal and distal convoluted tubules had varying degrees of degeneration and varying extent of necrosis.

Softening Enzyme Activity of Cucumber Flowers from Northern Production Areas

BELL, THOMAS A.; JOHN L. ETCHELLS, AND RALPH N. COSTILOW

Food Res. 23:198-204. 1958. (Journal Article 2102 from the Michigan Agricultural Experiment Station)

A preliminary survey was made in Michigan, Wisconsin, Indiana, and Ontario, during the cucumber season of 1955 to investigate the softening enzyme activity of flowers adhering to cucumbers. This has proved to be an important source of these enzymes in the southern states. The pectinolytic enzyme activity of flowers collected at brining stations ranged from 31 to 308 softening units (average 120) on a per flower basis, and flowers collected in the field ranged from 350 to 1,737 units (average 875). The range of cellulolytic enzyme activity was 213 to 2,199 units (average 680) for station flowers and 102 to 221 units (average 151) for flowers from the fields. These results indicate that cucumber flowers from northern production areas can possess a potential softening enzyme activity which, if introduced into curing vats in sufficient amounts under suitable conditions, could cause softening of the brined cucumbers in a manner previously demonstrated under southern conditions.

Growth Substances in Corn Pollen

FUKUI, H. N.; F. G. TEUBNER; S. H. WITTWER, AND H. M. SELL

Plant Physiol. 33:144-146. 1958. (Journal Article 2107 from the Michigan Agricultural Experiment Station)

3-Indoleacetic acid and two other growth promoting substances were observed in the acid fraction of corn pollen. The growth regulator in the "neutral" fraction did not possess an indole moiety.

The Effects of Time Interval Between Slaughter and Freezing on Toughness of Fryers

DAWSON, L. E.; J. A. DAVIDSON; MARY FRANG, AND SUE WALTERS

Poult. Sci. 37:231-235. 1958. (Journal Article 2109 from the Michigan Agricultural Experiment Station)

White Rock fryers, 11 weeks old, were slaughtered and processed in the conventional manner for this experiment. Half-birds were placed in a freezer (- 28° F.) at intervals of 40 minutes, 3 hours, 6 hours, and 24 hours after slaughter. After one month of frozen storage, samples of the half-birds from each group were cooked and evaluated for toughness. Samples from each treatment were cooked from the frozen state without prior thawing after 24 hours, 36 hours, and 48 hours in a household refrigerator. The fryers which had been frozen immediately after processing were found to be less tender than other groups, both by panel evaluation and by Warner-Bratzler shear force machine.

Effect of Certain Bacterial Inhibitors on Shelf-Life of Fresh Fryers

McVICKER, R. J.; L. E. DAWSON; W. L. MALLMANN; SUE WALTERS, AND EVELYN JONES

Food Tech. 12:147-149. 1958. (Journal Article 2110 from the Michigan Agricultural Experiment Station)

An evaluation of the effects on acceptable fryer shelf-life of chlorine and the antibiotics, chlortetracycline, and oxytetracycline was made.

Fryers cooled in ice water containing 10 p.p.m. chlortetracycline had lower bacterial counts and a longer shelf-life (as evaluated by raw odors and cooked flavor) than did those cooled in ice water, ice water plus chlorine, and ice water plus oxytetracycline.

Oxytetracycline and chlorine, in these two trials, were both less effective than chlortetracycline in extending shelf-life of fryers.

Cooked Meat Yields from Four Strains of Chickens, 6 and 16 Weeks of Age

DAWSON, L. E.; SUE WALTERS, AND J. A. DAVIDSON

Poult. Sci. 37:227-230. 1958. (Journal Article 2111 from the Michigan Agricultural Experiment Station)

Birds from four strains of chickens—(White Leghorns, White Rocks, Cornish X Rock, and University Cornish Crosses) were evaluated for cooked meat yields. Chicks were raised in batteries and representatives removed at 6 weeks of age for processing. One-half of the remaining birds received a 15 mg. injection of diethylstilbestrol at 9 and 13 weeks of age. Birds were then slaughtered at 16 weeks of age.

Total cooked meat yields from the raw ready-to-cook weights at miniature broiler age ranged from 48.52 percent (Leghorn) to 50.39 percent (Cornish Cross). At 16 weeks of age, the yields ranged from 50.13 percent (Leghorns) to 54.06 (Cornish X Rock). At 6 weeks of age the percentage edible cooked meat was not significantly different between strains. Yield from females was significantly higher than males.

At 16 weeks of age, the percentage of bone from the females was significantly lower than from the males and the hormonized birds yielded a higher drip and total cooking loss.

Some Effects of Hygromycin on Early Natural Infections of *Ascaris Lumbricoides* in Swine

LINDQUIST, W. D.

Jour. of the Amer. Vet. Med. Assoc. 132:72-75. 1958. (Journal Article 2116 from the Michigan Agricultural Experiment Station)

The recommended level of hygromycin B fed continuously to five pigs, did not prevent the migratory phase of ascarid infection as evidenced by liver scarring. Infected pigs on both medicated and unmedicated feeds showed a decreasing worm load with time on pasture and with increasing age and size of the pigs. This might be attributed to an immune response. Worm-free control pigs, on unmedicated feed, showed a greater weight gain than either the infected, medicated feed group or the infected, unmedicated feed group. From these data the merit of the antibiotic as an anthelmintic is difficult to evaluate.

Methodology for Studying Decision Making

JOHNSON, GLENN L.

Jour. of Farm Econ. 39:1215-1226. 1957. (Journal Article 2122 from the Michigan Agricultural Experiment Station)

Familiarity with Kentucky Bulletins 593, 619, North Dakota Bulletin 400, Bradford's and Johnson's *Farm Management Analysis*, Heady's *Economics of Agricultural Production and Resource Use*, Heady's and Jensen's *Farm Management Economics*, and Bouldings, *The Image*, is assumed. Methodological implications of experience with and results obtained from the Interstate Managerial Study (which is cooperative in seven midwestern states) are presented. The article has a strong empirical base. Only its general conclusions are presented in the following:

It is becoming increasingly clear that most of the academic disciplines can contribute information to decision makers. None of the disciplines, including economics, appears complete enough to encompass all of the managerial process. It is also clear that values are important in management, hence management appears simultaneously to be both a science and a humanity. When economists turn to the study of management, they appear to turn first to statistics and then to logic. Contrary-wise, when sociologists and psychologists study management they tend to ignore statistical and marginal analysis. Both tendencies appear to deter progress in the study of management. A corresponding tendency of mathematicians and statisticians to ignore other disciplines, particularly the humanities, also appears detrimental.

The specialized approaches to management followed by statisticians, mathematicians, sociologists, and psychologists are likely to contribute to the formulation of managerial thought. However, none appears complete enough to make more than a partial contribution.

Presently, unsettled conceptual problems preclude final decisions on "instruments" of measurement and methods of analysis. In view of this unsettled state of affairs, reasons exist for rather extensive use of case studies and elementary description to gain conceptual insights.

Ground Corn Cobs as a Source of Roughage for Lactating Dairy Cows

LASSITER, C. A.; C. F. HUFFMAN, AND C. W. DUNCAN

Jour. of Dairy Sci. 41:176-181. 1958. (Journal Article 2126 from the Michigan Agricultural Experiment Station)

Two studies were conducted with milking cows to compare ground corn cobs with alfalfa hay as a source of roughage. In both studies, a high protein (20.8 to 22.6 percent) grain mix was fed at a rate to supply Morrison's *(9)* minimum TDN standards (assuming that the corn cobs had the same TDN value as the alfalfa hay). In Trial I, corn cobs were substituted for hay at the rate of 8 and 16 pounds per day without affecting milk production, fat test, or body weight. An alfalfa-brome grass hay was used as a comparison which had a TDN value of 47.8 percent.

In Trial II, corn cobs replaced alfalfa hay up to 60 percent of the total roughage intake without affecting milk production and up to 80 percent of the total roughage without seriously affecting milk production. The TDN content of the alfalfa hay was 52 to 53 percent. When the cows were fed .4 pound of hay and 2.1 pounds of corn cobs per 100 pounds of body weight, consumption of

total roughage decreased 1.6 pounds per cow daily. Corn cobs appear to be equal to medium quality alfalfa hay up to the limit of the cows ability to consume corn cobs. Digestion trials were conducted in both studies, but no significant trends were noted.

Problems of Uncertainty in Farm Planning

HILDRETH, C.

Jour. of Farm Econ. 39:5. 1957. (Journal Article 2129 from the Michigan Agricultural Experiment Station)

Recent developments in theories of behavior under uncertainty are reviewed and their possible applications to problems of farm management are considered. An example of the application of the principle of minimizing the maximum loss is developed under the assumptions of a known production function and unknown price of output. It is suggested that proper formulation of decision problems is as important in practice as are reasonable methods for their solution.

Studies on Microbiological Methods for Predicting Shelf-Life of Dressed Poultry

MALLMANN, W. L.; L. E. DAWSON; B. M. SULTZER, AND H. S. WRIGHT

Food Tech. 12:122-126. 1958. (Journal Article 2135 from the Michigan Agricultural Experiment Station)

A new method for determining psychrophilic populations on dressed poultry by the use of a Phytone-Nacconol medium incubated at 20° C. for 72 hours by either the pour or drop plate technique is presented.

An indicator reduction test using a Phytone-Nacconol tetrazolium medium is also presented for detecting insanitary plant operations and a possible means of predicting shelf-life.

A total immersion method of determining bacterial population of the skin of dressed poultry was found more accurate than the swab technique.

Wound Area as Influenced by Closeness of Pruning

HERRING, H. G.; V. J. RUDOLPH, AND W. A. LEMMIEN

Jour. of Forestry 56:219-220. 1958. (Journal Article 2137 from the Michigan Agricultural Experiment Station)

Three pruning techniques as follows were applied to both living and dead branches of white and red pine. Treatment A: the branch was cut off just outside the branch base or collar, leaving a short stub; Treatment B: the branch was cut close enough to definitely wound the collar all the way around the branch base; Treatment C: the branch was cut as close to the bole as possible, removing all or most of the collar. With the same closeness of pruning and branch size, white pine had larger wounds than red pine. Treatment A gave the smallest wound areas. There was a relatively small increase with Treatment B and a large increase with Treatment C. Treatment B offers the best compromise between closeness of pruning and wound size.

Density of Potato Starch

ISLEIB, D. R.

Amer. Potato Jour. 35:428-429. 1958. (Journal Article 2152 from the Michigan Agricultural Experiment Station)

Density of starch from samples of eight potato varieties grown at three locations in Michigan was determined. Despite the wide divergence in specific gravity and starch grain size of the varieties investigated, no significant differences between densities of the starch samples were found.

Toxicity and Efficiency of Selected Herbicides on Representative Ornamental Plants

BIRDSELL, DUNCAN G.; DONALD P. WATSON, AND BUFORD H. GRIGSBY

Weeds 6:34-41. 1958. (Journal Article 2161 from the Michigan Agricultural Experiment Station)

The following species of ornamental plants, *Juniperus chinensis pfitzeriana, Taxus cuspidata, Ligustrum amurense, Lonicera tatarica, Spiraea bumaldi, Vinca minor,* and *Hedera helix baltica* were sprayed in July with the following at the rate of 54 gallons per acre: (a) 3-(3,4-Dichlorophenyl)-1-methyl-1-n-butylurea (Neburon) sprayed at the rate of 2 lb./A; (b) 2,4-Dichlorophenoxyacetamide (2,4-D amide) applied at the rate of 2 lb./A; (c) 2-Chloro-4, 6-bis (diethylamino)-s-triazine (CDT) applied at the rate of 8 lb./A; (d) 2,3,6-Trichlorobenzoic acid (2,3,6-TBA) applied at the rate of 2 lb./A; (e) 2-(2,4,5-Trichlorophenoxy) ethyl 2,2-dichloropropionate (erbon) applied at the rate of 80 lb./A; (f) No treatment.

All of the plants exhibited epinasty from sprays of 2,4-D amide.

CDT caused moderate to severe chlorosis on yew, privet, and ivy within 3 weeks.

No toxicity to plants from neburon was evident except for slight chlorosis on ivy and yew.

2,3,6-TBA showed immediate damage to all plants with injury being concentrated in the growing tips of the plants.

Overall toxicity to plants was greatest from erbon.

Best overall weed control was exhibited by erbon, followed by that from 2,3-D amide, CDT, neburon, and 2,3,6-TBA.

Complete freedom from weeds was observed on plots sprayed with erbon for a period of 10 weeks after treatments.

2,4-D amide controlled approximately 84 percent of the weeds 1 month after treatments.

CDT controlled approximately 79 percent of weeds 1 month after treatments.

With neburon approximately 72 percent of the weeds were controlled 1 month after treatments.

Approximately 73 percent weed control was obtained with 2,3,6-TBA 1 month after treatments.

Zinc Requirement of the Chick

ROBERSON, ROBERT H., AND PHILIP J. SCHAIBLE

Science 127:875-876. 1958. (Journal Article 2162 from the Michigan Agricultural Experiment Station)

Chickens fed a ration deficient in zinc grew poorly and utilized their feed inefficiently. They developed a severe dermatitis of the feet, frizzled wing feathers, infantile body feathers, and a goose-stepping walk. Addition of 100 p.p.m. zinc prevented these symptoms and permitted the birds to grow normally. The experiments demonstrate that zinc is required by the chick for normal growth, feather development, and skin condition as well as efficient utilization of feed.

New or Unusual Small Fruit Diseases and Disease-Like Occurrences in Michigan

FULTON, ROBERT H.

Plant Disease Reporter 42:71-73. 1958. (Journal Article 2172 from the Michigan Agricultural Experiment Station)

In surveying for new or unusual small fruit diseases *Armillaria mellea* was found on the cultivated blueberry, *Vaccinium australe Monilinia vaccinii-corymbosi* on pin cherry, *Prunus pennsylvanica*, were first reports on these hosts. Shoestring virus was reported for the first time in Michigan on blueberry; and a new symptom for shoestring; abnormal fruit coloring was disclosed for the Jersey variety. Fasciation was shown to be non-persistent in both black raspberry and strawberry. Aster yellows on strawberries was reported for the first time in Michigan. The occurrence of two non-parasitic myxomycetes on strawberry petioles and leaflets is presented. Finally, the infection of the originally resistant Fairland strawberry variety by *Phytophthora fragariae* is reported from Michigan for the first time.

Effect of Reserpine on Prolactin Content of Rabbit Pituitary

MEITES, JOSEPH

Proc. of the Soc. for Exper. Biol. and Med. 97:742-744. 1958. (Journal Article 2195 from the Michigan Agricultural Experiment Station)

1. A single intravenous injection of 1 mg. reserpine/kilo/body weight into five mature female rabbits, followed by sacrifice 1 week later, resulted in at least a five-fold increase in pituitary prolactin content over five controls. There was no evidence that reserpine induced mammary growth or lactation.

2. Subcutaneous injections of .2 mg. estradiol daily for 10 days into six rabbits elicited 1 week later at least a 10-fold increase in pituitary prolactin content, a slight growth of the mammary duct system and no milk secretion.

3. When estradiol treatment was followed by a single intravenous injection of reserpine (above dose) and the rabbits killed 1 week later, pituitary prolactin content was at least 16 times greater than in controls. This was accompanied by a considerable degree of lobule-alveolar development and a limited amount of milk secretion in all six animals.

Assay for the Solids-Not-Fat of Cows Milk

BRUNNER, J. R.

Jour. Dairy Sci. 41(3):444-447. 1958. (Journal Article 2210 from the Michigan Agricultural Experiment Station)

The small Watson pattern lactometer offers a method sufficiently accurate and simple to use in large scale testing programs either in a laboratory or field application.

The formol titration appears to be best suited as a rapid and simple method for the estimation of the protein content of milk under field conditions.

A recently developed technique utilizing the protein binding capacity of Orange G might possibly offer a practical method for measuring the proteins of milk at the laboratory level.

More sensitive estimation equations for T.S. and SNF from lactometer readings and corresponding prediction equations for estimating highly correlated components can be derived from mass data obtained under local conditions.

The direct determination of T.S. of SNF by sensitive gravimetric techniques remains in the realm of laboratory procedure.

Root Anatomy and Growth Habit of Some Alfalfa Varieties in Relation to Wilt Resistance and Winter-Hardiness

SETH, JAGDISH, AND S. T. DEXTER

Agronomy Jour. 50:141-144. 1958. (Journal Article 2211 from the Michigan Agricultural Experiment Station)

Five bacterial wilt-resistant and five wilt-susceptible varieties of alfalfa, ranging from very hardy to nonwinter hardy in each group, were planted in the field and in the greenhouse with continuous long and long-to-short days. Roots were dug from the field in October, December, and February and from the greenhouse cultures for microscopic study on triple stained slides.

The slides were measured for variations in cell and tissue structure and size, and for starch content by staining with iodine.

In no way could the anatomy of the wilt-resistant varieties be differentiated from that of the susceptible varieties. Short days caused a notably decreased and recumbent top growth in the winter hardy varieties. The annual growth rings of the field-grown roots of hardy varieties showed large xylem vessels formed during long days and small during shorter days. The same contrast in vessel size was seen in the greenhouse-grown roots of hardy varieties. The contrast in xylem size due to change in day length was less prominent in nonwinter hardy varieties.

Reducing Costs with Low Pressure Steam

HALL, CARL W.

Amer. Milk Rev. 20:52-54. 1958. (Journal Article 2214 from the Michigan Agricultural Experiment Station)

Steam costs in a dairy plant can be reduced by one-fourth to one-half with low pressure steam generated below 15 p.s.i. Low pressure steam is less expensive because of reduced labor costs, lower fuel costs, and less maintenance of equipment. Where temperatures above 240° F. are needed, steam pressures

must be used in excess of 15 p.s.i. In most installations, larger lines are needed for carrying the low pressure steam. The physical properties of low pressure steam, the installation and operation utilizing low pressure steam, and the advantages and disadvantages of low pressure steam are presented.

Studies on Transmission of Verticillium Wilt of Eggplant in Michigan

BURTON, CLYDE L., AND DONALD J. DEZEEUW

Plant Disease Reporter 42:427-436. 1958. (Journal Article 2220 from the Michigan Agricultural Experiment Station)

A series of laboratory assays and greenhouse and field experiments to determine the importance of seed transmission of *Verticillium alboatrum* causing eggplant wilt was made between 1955 and 1957. Laboratory assays and greenhouse plantings of commercial seed lots showed no infection. The disease was induced readily in plants by inoculation and the organism could be isolated from fruits of these plants but only one fruit produced seeds bearing the organism. The infestation, in this case, appears to have been via contact of soil with the fruit. The results of all the experiments lead the authors to conclude that seed transmission of *Verticillium* wilt of eggplant is extremely unlikely in practice. Some cultural practices minimizing the damages of *Verticillium* wilt in eggplant are discussed.

The Quarterly Bulletin

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents progress reports on long-term major research projects and final reports on short-term projects.